A McGRAW-HILL ELECTRONICS PUBLICATION

SEPTEMBER 10, 1984 $3

# ElectronicsWeek®

**FutureNet's latest logic designer**

**ENHANCED IBM PC AT/81**

1 OCT REC'D

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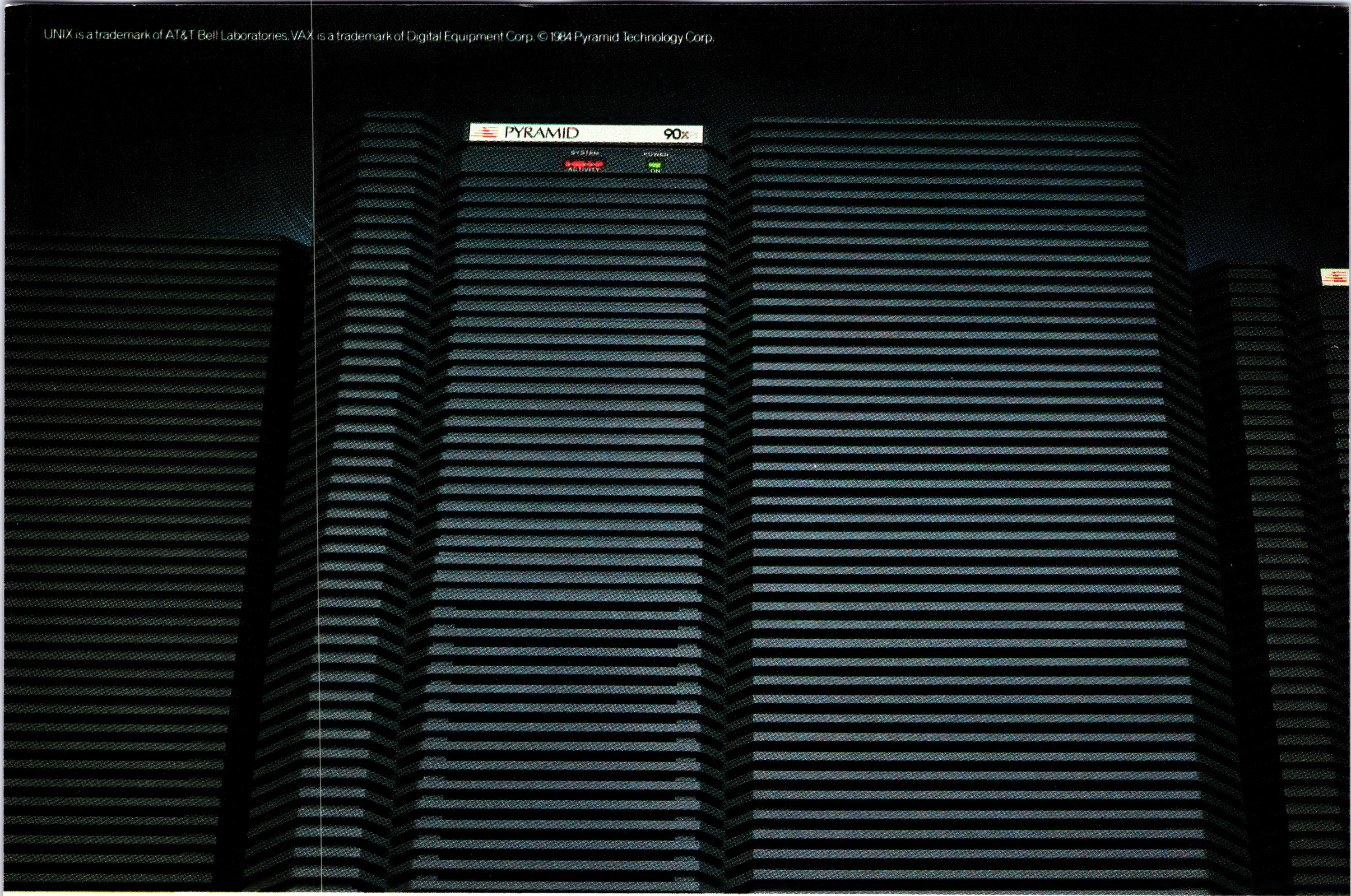

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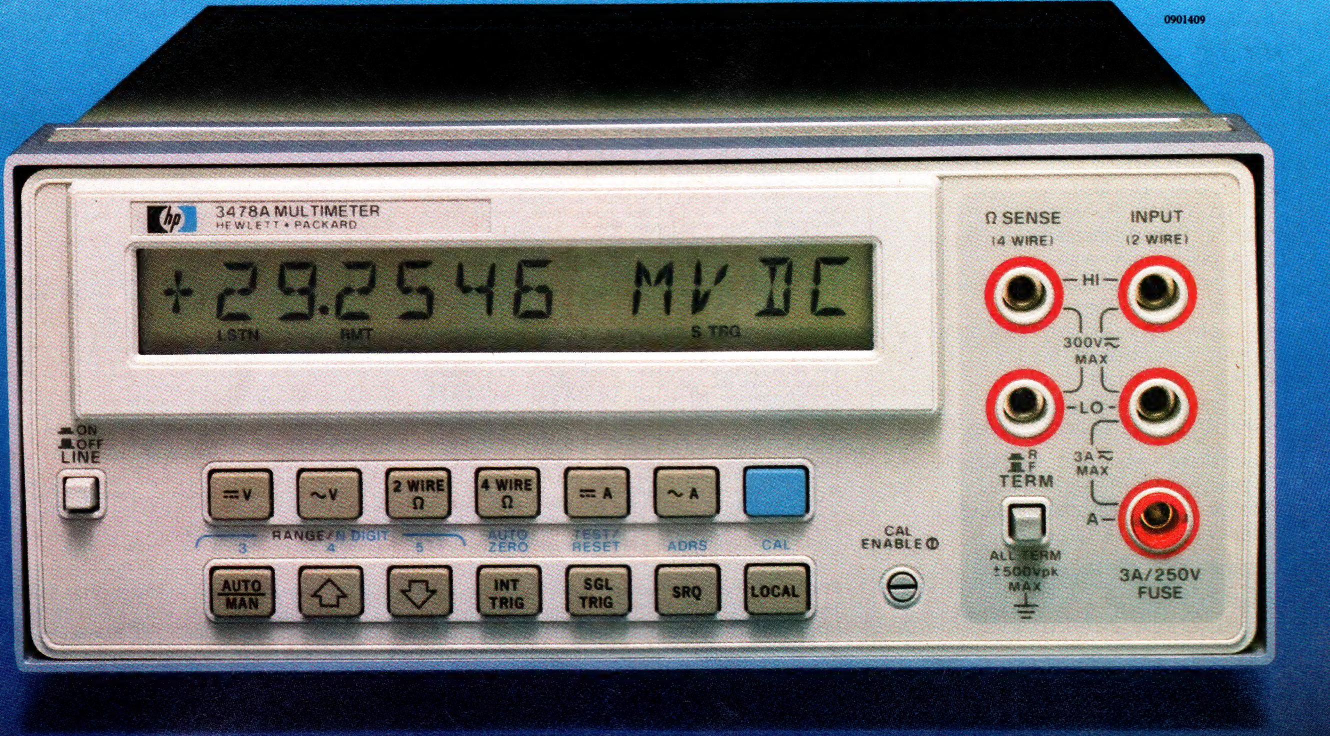

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## *Next ElectronicsWeek*

### VLSI packaging trends: a special report

The design of packages for very large-scale integrated circuits is rapidly approaching the stage where it is almost as important as the design of the chip itself. The fastest, densest IC ever invented is useless if it cannot be electrically, mechanically, and thermally interfaced to the next level of interconnection—and so packaging designers and users face a challenge that grows more complex each year. At the same time, the VLSI packaging field is in a state of flux brought on by the growing multiplicity of packages and the appearance of multichip packages. For an understanding of the fast-changing dynamics of VLSI packaging, read next week's special report by *ElectronicsWeek's* Packaging and Production Editor, Jerry Lyman.

### LCD addressing techniques assume new importance

As designers seek to take advantage of liquid-crystal displays' inherently low power consumption and high readability, even in sunlight, addressing techniques are receiving renewed attention. These designers want larger displays than the typical watch or calculator displays so prevalent today, and such LCDs require advanced addressing techniques to avoid problems with speed limitations and cumbersome lead configurations. Birendra Bahadur of Data Images Inc. has researched the latest technology for readers of the next issue of *ElectronicsWeek.*

## *Looking ahead in ElectronicsWeek*

### Cutting OEM gate-array turnaround and costs

Until recently, gate-array designs involved expensive mainframe use and months of time. Now, a time-sharing service called Unicad-1 promises to cut time nearly in half and slash the cost to original-equipment manufacturers. Read about Unicad-1 in an upcoming *ElectronicsWeek.*

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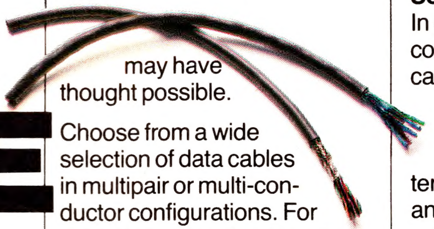

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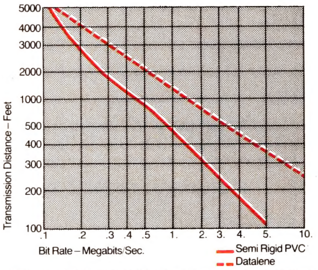

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# ElectronicsWeek

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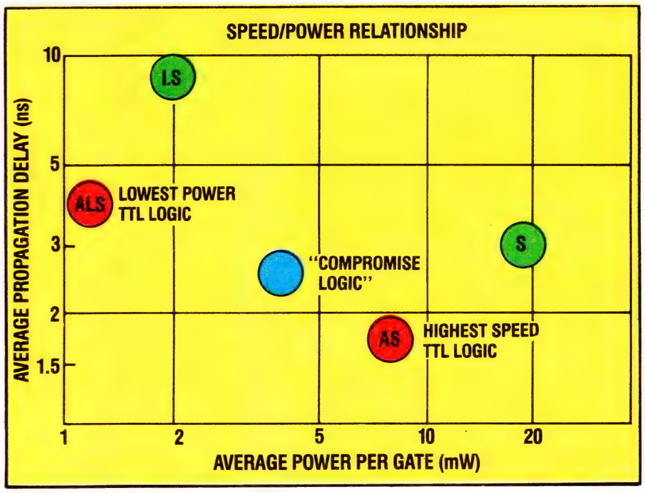

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# Meetings

**Convergence '84—The Sixth International Congress on Transportation Electronics,** Vehicular Technology Society *et al.* (Bruce McCristal, General Motors Corp., 10-263 General Motors Bldg., Detroit, Mich. 48202), Hyatt Regency Hotel, Dearborn, Mich., Oct. 22-24.

**International Symposium on Noise and Clutter Rejection in Radars and Imaging Sensors,** IEEE *et al.* (Toshimitsu Musha, Department of Applied Electronics, Tokyo Institute of Technology, 4259, Nagatsuta, Midori-ku, Yokohama, 227, Japan), Sasakawa Hall, Tokyo, Oct. 22-24.

**10th International Symposium for Testing and Failure Analysis,** The International Society for Testing and Failure Analysis (ISTFA, P.O. Box 4110, Torrance, Calif. 90510), Los Angeles Airport Hilton Hotel, Los Angeles, Oct. 22-26.

**10th International Conference on Industrial Electronics,** The Society of Instrument and Control Engineers, IEEE (Robert Begon, Conference Arrangements Chairman, FMC Corp.-ODE, M/S 070, Box 1201, San Jose, Calif. 95108), Keio Plaza Inter-Continental Hotel, Tokyo, Japan, Oct. 22-26.

**GaAs IC Symposium,** IEEE (R. Allen Murphy, Lincoln Laboratory, Massachusetts Institute of Technology, Box 73, Lexington, Mass. 02173), Copley Plaza, Boston, Oct. 23-25.

**Semicon/Southwest '84,** Semiconductor Equipment and Materials Institute (Susan Castillo, SEMI, 625 Ellis St., Suite 212, Mountain View, Calif. 94043), Market Hall, Dallas, Oct. 23-25.

**Personal Computers in Business and Government,** National Institute for Management Research (Dept. PR, NIMR Seminars, P.O. Box 3727, Santa Monica, Calif. 90403), Sheraton National Hotel, Washington, D.C., Oct. 24-26.

**International Symposium on Computers in Children's Education,** Programa Universitario de Compúto of the Universidad Nacional Autónoma de México (Programa Universitario de Compúto-UNAM, Direccion General, Apdo. Postal 20-059, Deleg. Alvaro Obregon, 01000, Mexico, D.F.), Palacio de Mineria, Mexico City, Oct. 24-26.

**Fourth National Security Issues Symposium,** U.S. Air Force and Mitre Corp. (Rosanne Shiner, Mitre Corp., Burlington Rd., Bedford, Mass. 01730), Mitre Corp., Bedford, Oct. 25-26.

**Document-Based Optical Mass Memory Systems Conference,** Institute for Graphic Communications Inc. (Richard D. Murray, Director of Conferences, Institute for Graphic Communication Inc., 375 Commonwealth Ave., Boston, Mass. 02115) Airlie House, Airlie, Va., Oct. 28-30.

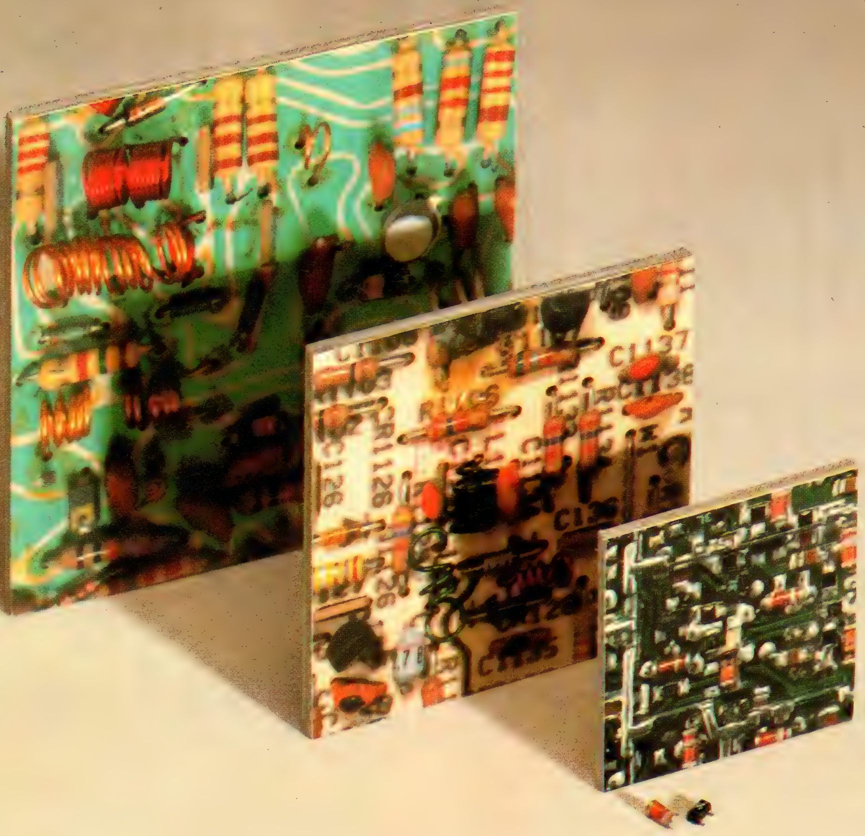
**126th Technical Conference and Equipment Exhibit,** Society of Motion Picture and Television Engineers (SMPTE Conference, 862 Scarsdale Ave., Scarsdale, N.Y. 10583), New York and Sheraton Centre hotels, New York, Oct. 28-Nov. 2.

**Third Pacific Northwest Computer Graphics Conference,** University of Oregon Continuation Center (Conference Manager, Third Annual Pacific Northwest Computer Graphics Conference, Continuation Center, 333 Oregon Hall, University of Oregon, Eugene, Ore. 97403) Hilton Hotel, Eugene, Oct. 29-30.

**Photovoltaic Advanced Research and Development Sixth Review Meeting,** Solar Energy Research Institute (SERI, Conference Coordination Section, 1617 Cole Blvd., Golden, Colo. 80401), Denver Marriott West, Golden, Oct. 29-31.

## Seminars

**Frequency Measurements,** National Bureau of Standards (Mike Lombardi, Time and Frequency Division, NBS, 325 Broadway, Boulder, Colo. 80303), NBS Boulder Laboratories, Boulder, Oct. 24-25.



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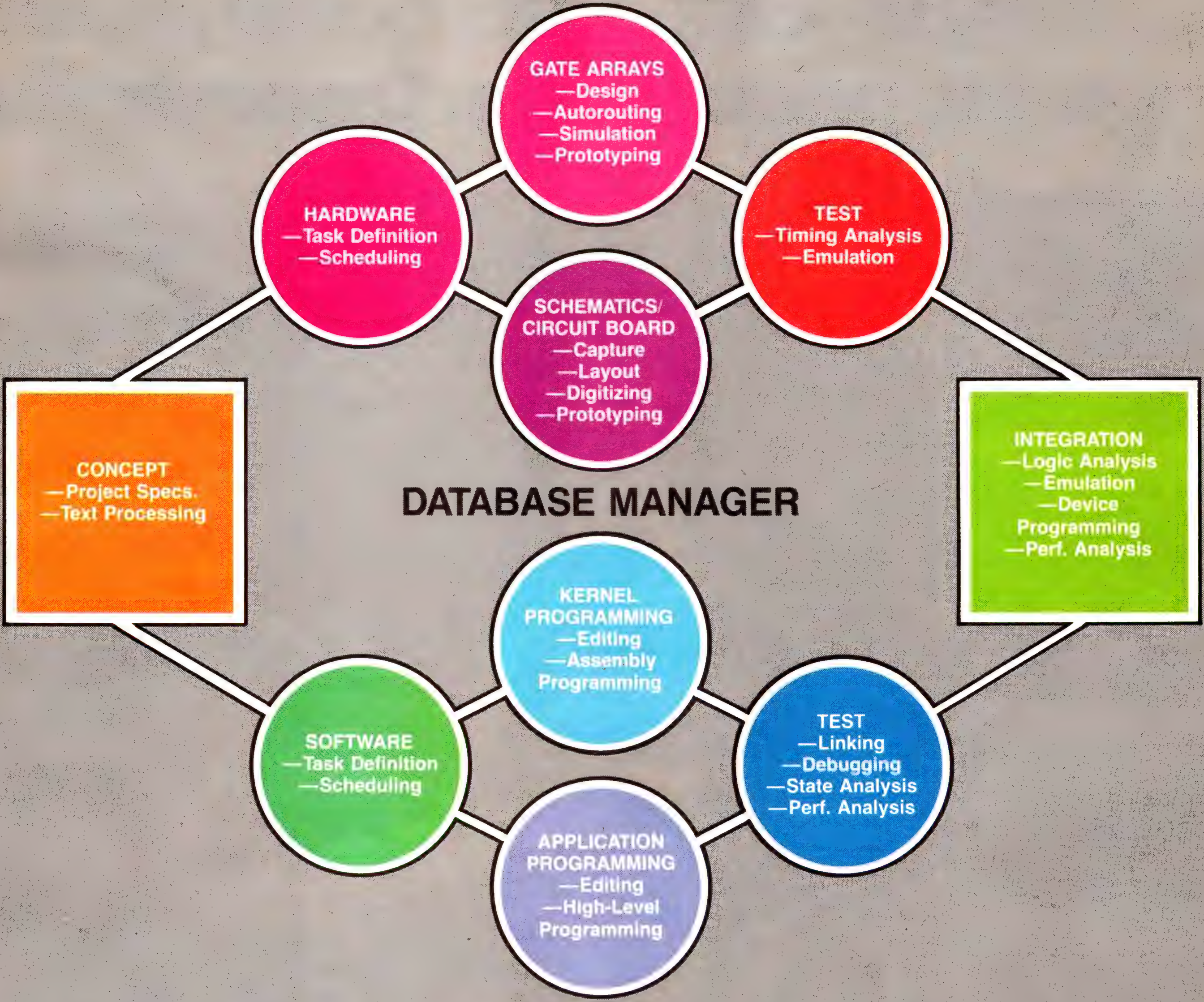

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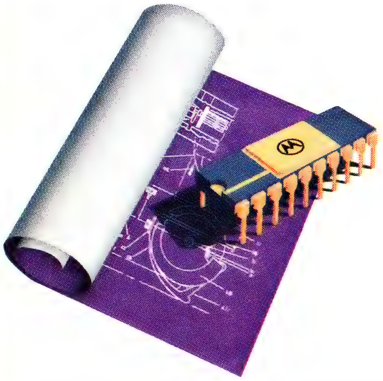

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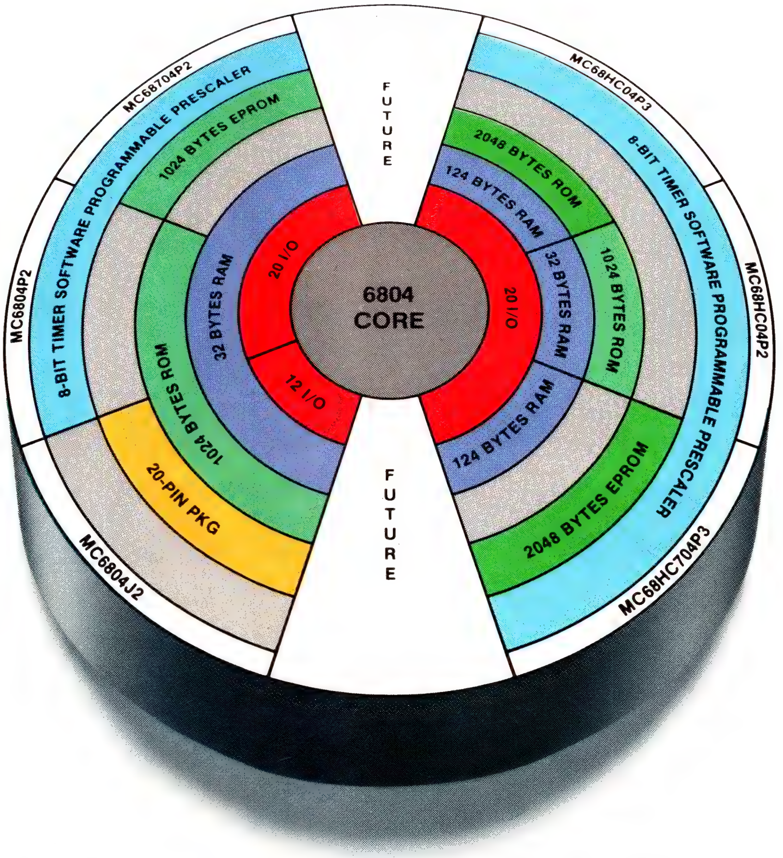

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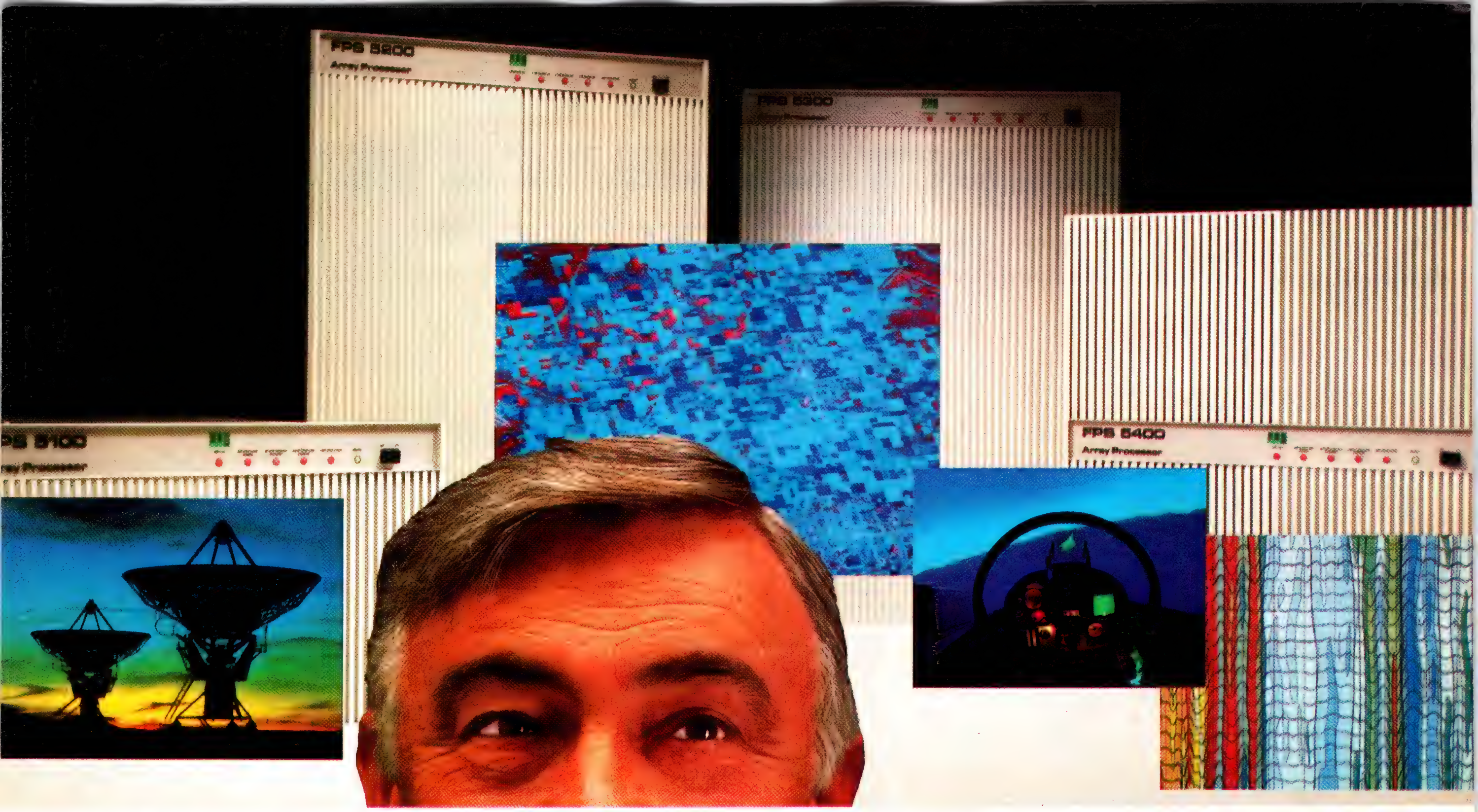

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# CMOS CIRCUITS EDGE BELOW 1 MICROMETER

IC processing advances made in military's VHSIC program are finding their way into merchant chip makers' arsenals

☐ *By J. Robert Lineback*

Thanks in part to lessons learned in the first phase of the military's Very High-Speed Integrated-Circuits program, U.S. commercial chip makers have mustered the confidence to push complementary-MOS technology to the 1-μm level and below. VHSIC's now-apparent side effect on commercial chip development is providing the kind of ammunition government officials had hoped for after years of complaints that little was being done to aid domestic firms against aggressive competition from the Japanese.

Although not directly involved in the VHSIC work at Texas Instruments Inc., memory-circuit developers at TI's process laboratory in Houston were so encouraged by efforts in the firm's military program that they succeeded in fabricating experimental very large-scale integrated circuits using a new 1-μm CMOS technology. The new technology, which represents a fistful of key processing advances, is now a likely candidate for TI's coming generations of commercial VLSI circuits, including 1-megabit dynamic random-access memories.

In Phoenix, Ariz., the Semiconductor Products Sector of Motorola Inc. continues to draw on its upbeat VHSIC experience. Late in August, Motorola—which is working with TRW Inc. as one of the half-dozen VHSIC teams [*ElectronicsWeek*, Sept. 3, p. 17]—announced what it believes is the first fully functional 1-K static RAM fabricated by a 0.5-μm CMOS process.

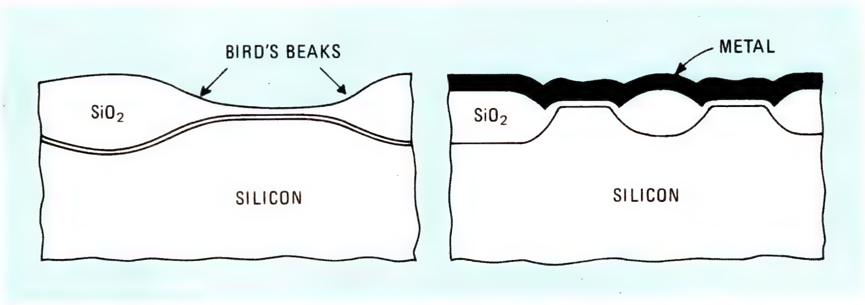
"We have actually gotten functional devices at one fourth of a micron," states W.J. Kitchen, director of strategic programs. He quickly adds, however, that second- and third-order effects usually found in chips measuring more than 1-μm become tougher problems at smaller dimensions.

**Proved out.** "I think many of the 1-μm processing techniques have been explored and somewhat proven out in VHSIC. We understand the lithography associated with that level much better," Kitchen notes. "I believe Motorola's position is now that you can get 1-μm lithography from wafer steppers, and at submicrometer it will likely require a mix-and-matching of steppers with electron-beam direct write."

Because finer geometries approach the wavelength of light, many in the industry have believed optical photolithography techniques will soon be supplanted by other lithography techniques, such as electron-beam or X-ray. But each year, conventional wafer-stepping lithography manages to achieve yet finer geometries.

Another strategy on the fine-line front comes from RCA Corp.'s Solid State Technology Center, Somerville, N.J., where silicon-on-sapphire is the leading CMOS technology for the 1.25-μm phase of VHSIC. RCA is a second source to Hughes Aircraft Co. in the military chip program and has fabricated a 1.25-μm, 2,700-gate universal array whose metal lines can be automatically routed by software. Researchers are now preparing to push the technology to the 0.5-μm level under Phase 2 of VHSIC. Already, RCA has seen SOS CMOS success at the 0.7-to-0.8-μm level with experimental arithmetic and logic units, explains T.E. Sullivan, manager of device engineering at the center.

**Alternative.** Sullivan believes that silicon-on-insulator materials—like SOS—will be the best alternative to bulk silicon, which with conventional processing techniques presents a number of problems in isolating tightly packaged transistors. SOI forms islands on the chip, physically



**Beak tweak.** To overcome the sloping edges of surface-grown oxide, known as bird's beak (left), TI has devised an isolation process that places $SiO_2$ below the substrate surface (right).

## TI chip tests 1-μm CMOS process

Lured by the millions in profits that early chip introductions can bring, Texas Instruments Inc. launched an unusual project two years ago to design very large-scale integrated dynamic random-access memory test chips for a new 1-μm complementary-MOS process. The Dallas firm achieved working chips this summer and bared some details about them in early September at a press briefing in Montauk, N.Y.

"This is the first time that we have ever taken a true VLSI part and used it to prove a number of process inventions," states Gollapudi R. Mohan Rao, manager of advanced semiconductor development. "It represents a major investment on the part of TI, and we have spent significant resources to do it." But TI believes the price will be well worth it, since the aim is to create a 1-μm CMOS technology that can yield a broad line of VLSI component types—including megabit memories, advanced logic, and powerful microprocessors—that it can market before its competitors come out with similar parts. TI expects to have 1-μm CMOS DRAMs in production in 1985.

Usually, fabrication techniques are tested on sections of larger ICs. TI's MOS operation in Houston, however, went directly into full-scale VLSI dice. Success can mean big profits. For example, in dynamic memory markets, early introductions of chips (by six to nine months) can result in 20% to 30% additional profits over the lifetime of the part. **–J.R.L.**

separating n- and p-type structures, while bulk silicon traditionally relies on grown-oxide isolation. "From a commercial standpoint, the difference in cost of starting material will become less of a factor in the future," Sullivan predicts.

But TI—also experimenting with SOI—believes 1-μm CMOS can be achieved for many VLSI commercial components using bulk silicon, three-dimensional circuits, and commercially available wafer-stepping equipment. In an unusual move to prove the belief, the Houston process lab launched an aggressive development project to build complete VLSI dynamic random-access memory chips with more than 100,000 active elements by using the new processing advances, says Gollapudi R. Mohan Rao, senior vice president and manager of advanced semiconductor development at TI. The move represents an attempt to speed up development and beat the competition to VLSI markets (see "TI chip tests 1-μm CMOS process," above).

**Fine pitch.** The new CMOS process yields 1-μm features, spaced 1 μm apart. This 2-μm pitch (line width plus spacing) was in part made possible by the key processing advance, a new TI-patented isolation technique that places oxidation under the planar surface, on which transistors are placed. Called modified fully framed, fully recessed isolation, MF$^3$R allows 1-μm isolation and greatly minimizes the "bird's beak" shape normally associated with local oxidation of silicon isolation (see figure). This LOCOS technique, used in MOS production for more than a decade, is a technique to grow oxide selectively on the surfaces of wafers.

TI's MF$^3$R uses an oxide-nitride sandwich to create pad dielectric isolation. The technique consists of etching into the silicon and then filling in with oxide. The 1-μm process features a gate of pure refractory metal to reduce the electrical resistance in the interconnection. The lightly doped drain suppresses hot electrons while a cladded moat is used to lower interconnection resistance of the diffusion. The CMOS process also allows capacitors to be built in the third dimension. Three-dimensional transistors are expected in the future, as well.

TI's VHSIC work, which falls under the aegis of the Equipment Group, in Dallas, is producing 25-MHz 72-K static RAMs from 1.25 μm n-channel MOS technology. MOS memory officials in Houston have concluded that n-MOS will not likely suit commercial chips sporting submicrometer geometries because of power dissipation from hot electrons.

## MEMORIES

# Britain's Sinclair readies 1-megabyte wafer-scale memory as a replacement for today's Winchester disk drives

**London—**By late 1985, Britain's inventive knight, Clive Sinclair, hopes to have on the market a solid-state replacement for today's Winchester disk drive. Expected to be just over 4 in. in diameter and about ⅛ in. thick, the basic storage medium—a packaged wafer of silicon—will be able to hold half a megabyte of serial memory.

With an estimated access time of 10 μs and a power consumption of 1 W, this wafer-scale mass store will be 1,000 times faster and consume 1/10th the power of its electromechanical predecessors, Sinclair maintains. He also points out that it will be several orders of magnitude smaller and more reliable as well, able to test and repair itself, if necessary, every time it is switched on.

Sinclair reckons that the cost per bit will be less than for conventional random-access memory. Virtually all the new storage medium's cost is in the wafer circuit, which costs between $75 and $150 to process.

To get such a prodigious product to market, Sinclair must succeed where others—most conspicuously,

**Revolutionary.** Sinclair's plug-in wafer-scale mass memory stores 0.5 megabyte of data, doing for the QL computer what a small Winchester disk drive does for other personal computers.

Trilogy Systems Inc. of Cupertino, Calif.—have failed. Last month, Trilogy reported that it had abandoned its four-year multimillion-dollar effort to fabricate wafer-scale circuits, its scheme literally short-circuited by pin-hole defects in the fancy multilevel technology used to interconnect transistors on the wafer's surface. Trilogy's failure doesn't faze Sinclair, who says his circuit-on-a-wafer scheme differs fundamentally from most others.

For one thing, Sinclair uses industry-standard semiconductor technology with no new production wrinkles to iron out. All the novelty lies in the unusual wafer-scale architecture patented over 12 years ago by Ivor Catt (see "Wafer-scale circuit repairs itself," below).

**Workable.** Furthermore, Sinclair is riding on the back of 12 years of research at Middlesex Polytechnic, Brunel University, and, most recently, Burroughs Machines Ltd.'s Cumbernauld Research Centre in Glasgow. There, Catt's ideas were successfully demonstrated three years ago, when J. Malcolm Wilkinson, who then headed the effort in electronics and new technology, produced a batch of wafer-scale chips that worked the first time, with acceptable yields [*Electronics,* Sept. 22, 1981, p. 73].

Based on these results, Wilkinson estimated that a fully optimized design, using a 3-μm n-MOS process, instead of the original 5-μm process, would put 1.6 million bits, or 0.2 megabyte, of serial data storage onto a 4-in. silicon wafer. Since typical dissipation would be around 8 W, air cooling would be adequate.

Today, Wilkinson runs Sinclair Research Ltd.'s wafer-scale operation. (Burroughs shelved its program when the company got into financial difficulties. About the same time, Mosaic Systems Inc., Troy, Mich., was spun off from the parent company. Mosaic is still developing its wafer-scale device.)

Having purchased the rights to the Catt patents, Sinclair and Wilkinson are talking about putting at least 0.5 megabyte of serial memory onto a silicon wafer with a power consumption of 1 W, an advance on the earlier estimate that could be achieved by an improved design, better yields, and larger wafers, or by a combination of all three.

Sinclair will team the solid-state Winchester replacement with his QL 32-bit microcomputer [*Electronics,* Jan. 26, 1984, p. 78]. The $500 machine, designed around a Motorola 68008 microprocessor, features twin miniature Microdrives, each with 100-K bytes of capacity, and an integrated business software package from Psion Ltd. of London.

The solid-state Winchester will plug directly into a socket already provided on the QL (see photograph). Since a semiconductor memory loses its contents when the com-

## Wafer-scale circuit repairs itself

The solid-state Winchester disk drive replacement under development at Sinclair Research Ltd's. Metalab, near Cambridge, will use a single self-testing and -repairing wafer-scale circuit, based on a scheme first worked out and patented by Ivor Catt some 12 years ago and subsequently refined in several UK research laboratories.

Catt uses standard semiconductor-wafer processing and a novel serial array to dynamically form a large shift register. The technique works even when many of the chip sites—all identical serial registers with a small amount of additional switching and control logic—are faulty.

Good chips link up to form a single structure, without additional metalization or even prior knowledge of which chips are good. Neighbor-to-neighbor connections are made by means of simple gate structures, while test patterns, injected at one end of the chain, check that each new link—or chip site—is good.

Test patterns and control signals are injected into the chain under control of an external microprocessor, which adds to the chain till a pre-determined length has been reached or all chip sites have been tested. In its simplest form, the resulting circuit comprises a single segmented shift register. Data can be clocked on and off, in much the same way as with a Winchester disk. Faster access times and data rates can be obtained by breaking up the single serial loop into several smaller loops or by adding a further control line linking all active cells. Functions considerably more complicated than a single shift register—such as signal processing and voice recognition—can be carried out by the arrays if smart control lines are implemented. **–Kevin Smith** puter's power is off, the Winchester unit will incorporate a battery that powers the wafer-scale circuit in its stand-by mode. However, the slower-but-cheaper continuous-loop Microdrives will still be needed for making permanent file copies. Their average access time is a sluggish 3.5 s.

If Sinclair can bring it off, the solid-state Winchester should turn Sinclair Research Ltd.'s QL personal computer from a tortoise into a greyhound. But history has shown that few Sinclair launches—even the latest QL computer—have gone smoothly. –**Kevin Smith**

## MILITARY

# Tripled-up digital system flies X-29

**Calverton, N.Y.—**Hidden within the sleek skin of Grumman Aerospace Corp.'s X-29 prototype fighter is a triply redundant digital flight-control system. Without the computers, the plane would be virtually unflyable: its distinctive swept-forward wings, designed for rapid supersonic maneuvering, result in a plane that is as tricky to control as a 40-ton tractor-trailer speeding across an ice-covered bridge

Indeed, a pilot using a conventional system would be unable to fly the X-29 because he could not adjust the control surfaces with the required precision, says Ted Rue, manager of the flight-control program for system designer Honeywell Inc.

The three-channel digital system, designed by Honeywell's Military Avionics Division in St. Louis Park, Minn., is not only triply redundant, but has an analog backup for each digital computer. Each computer has two Honeywell HDP-5301 processors for sufficient throughput margins for the complex control demands and redundancy management.

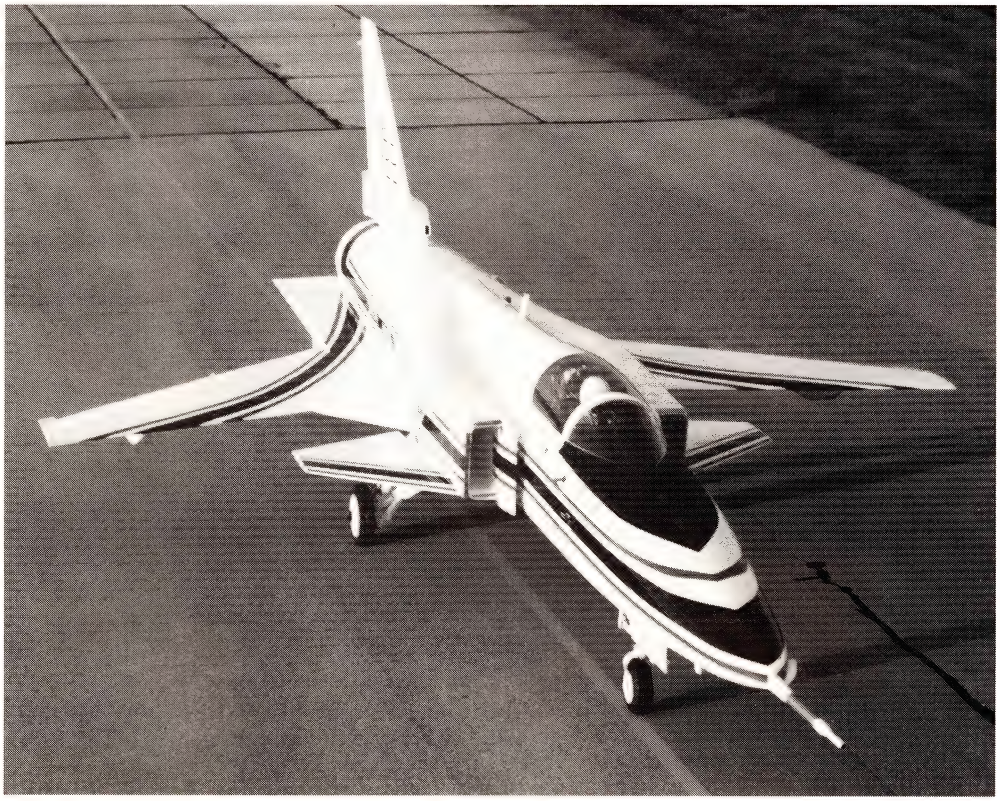
**Test bed.** The X-29 program, funded in part by the Defense Advanced Research Projects Agency and managed by the Air Force Aeronautical System Division's Flight Dynamics Laboratory, at Wright-Patterson Air Force Base, Dayton, Ohio, is designed to test several advanced design features aimed at creating a new generation of small, fuel-efficient fighter aircraft. The forward-swept wing, made of strong, lightweight graphite composites, can be fine-tuned in flight for rapid maneuvers. The flight-control computers stabilize the aircraft by adjusting the wing edge, the two forward canards, and rudder and strake flap-control surfaces.

The system's fly-by-wire technology, which Rue says was developed by Honeywell and several other avionics firms about 10 years ago, replaces the cables and pushrods of conventional systems with computers, wires, and sensors. It assesses flight conditions—including attitude, speed, and altitude—and feeds the data to the flight computer. The computer then adjusts the control surfaces, transmitting up to 40 commands a second.

"Even if there are a number of failures, there'll still be digital or analog backups," says Rue. If one digital system fails, the remaining two take over. If two digital systems fail, the flight control system switches to the analog mode. If one of the analog computers fail, the two remaining analog computers take over. The flight control system's data exchange is completely under software control. "The software is getting more and more complicated," notes Capt. Nancy Crowley, software engineer for the X-29 Advanced Development program, making it more difficult to prove correct.

According to Grumman, the use of digital flight control is relatively new. Because baseline data is programmed into its software, the digital system is easier to modify than its analog counterpart, which would require hardware modifications.

Louis Leet, an aeronautics engineer at the Flight Dynamics lab, says an unusual feature of this airborne system is the two central processing units in each computer, with tasks apportioned between them. The basic requirement of the system, Leet continues, is to withstand two system



**Hands off!** The flight control system in Grumman's experimental X-29 can fine-tune control surfaces with better-than-human precision.

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failures and still allow a pilot to return to base safely. Thus, Leet considers complete failure of the system as an unlikely possibility.

Rue says Honeywell began development of the flight control system for the X-29 in 1981, the same year Grumman won a $93 million contract to build two demonstration planes. Grumman says it has invested $40 million in the program, including $25 million in 1984. For the past year and a half, it has been testing the entire digital and analog flight control system using a hybrid simulator with a mathematical model of the X-29's flight characteristics to operate the laboratory system.

Grumman says it will test fly the X-29 later this year at Edwards Air Force Base, Calif., before turning it over to the National Aeronautics and Space Administration, which is testing it. –**George Leopold**

## SEMICONDUCTORS

# Multifunctional transistors use bipolar, lateral technology fine-tuned to deliver next-generation performance

**Tokyo**—Integrated-circuit manufacturers in Japan now find that they must develop technologies suitable for the entire range of electronics products—ranging from low-power complementary-MOS circuits to high-voltage display drivers and telephone subscriber-line interface-cards—having multiple functions on the same chip. Moreover, in consumer and telecommunications electronics, it is often necessary to design chips with both analog and digital functions implemented with a combination of bipolar and MOS transistors. Then amplifier and filter circuits can be combined with processor and memory circuits.

Hitachi Ltd. appears to be doing an especially good job of mobilizing its research laboratories and production works for this purpose, as indicated by three papers given at the International Conference on Solid State Devices and Materials held in Kobe at the end of last month.

Closest to the mainstream is a bi-CMOS technology for fabricating, on a single chip, a complete spectrum of active devices with minimum degradation of characteristics compared with devices fabricated by more specialized processes. Yutaka Okada and his co-workers at Hitachi's Central Research Laboratory here and engineers at the firm's Takasaki Works in Takasaki developed the process, called ABC (for advanced bipolar-complementary-MOS) very large-scale integrated-circuit technology. Capabilities include npn, pnp, and integrated injection logic bipolar transistors and n- and p-channel MOS field-effect transistors.

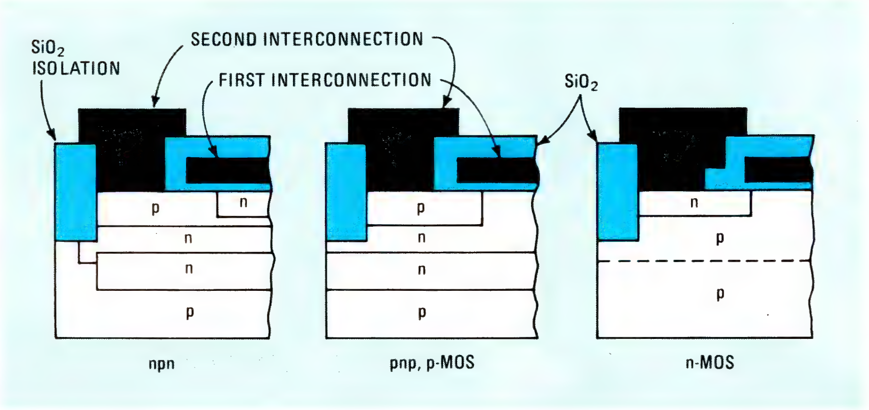
State-of-the-art performance is featured by the new process, which requires perhaps another year for development. MOS devices have channel lengths of 3 μm, the same size used in many high-performance n-MOS and CMOS parts other than memories. Bipolar transistors have a gain-bandwidth frequency $f_t$ of 3 GHz, more than adequate for most applications.

Fabrication requires four more masks than standard bipolar devices—about the same number now used for standard CMOS chips. Five implantation steps are used to set doping levels, but this is about par for modern ICs. A self-aligned process is used for opening bipolar transistor base contacts to give smaller dimensions.

**Keeping the well shallow.** The new technology uses a 2-μm or less n-type epitaxial layer on p-type wafers because it helps reduce the gate area of the bipolar transistors and simplifies fabrication of n-channel MOS FETs. The p-well diffusion is driven to the p-substrate during fabrication of the p-type isolation region of the bipolar transistors (see figure, left). This configuration eliminates the need to form a deep p-well to eliminate latchup.

Many process steps are common for different devices. What is known as the graft base—the low-resistance external base region—of the npn transistors is formed in the same step as the source and drain regions of the p-MOS transistors. The lateral pnp bipolar transistors are similar to p-channel MOS FETs, with an $n^+$ base connection off to the side of what would be the channel rather than a gate overlying it.

In addition, the same interconnection layers are used for both MOS and bipolar transistors. And by optimizing the doping levels, inverse npn transistors for $I^2L$ can be fabricated in the same process steps



**Thin is in.** Advanced bipolar-CMOS fabrication technology is able to implement npn, pnp, p-MOS, n-MOS, and $I^2L$ devices in the same substrate for flexibility of circuit design. Only half of each device is shown. The lateral pnp is the injector for the $I^2L$ devices.

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as are conventional pnp transistors.

Several reasons can be given for the higher performance of the npn bipolar transistors fabricated by this process compared with those fabricated by conventional bi-MOS processing. The use of $n^+$ buried layers greatly reduces series collector resistance. Base width is only 0.3 $\mu$m, much less than in conventional bi-MOS technology, and the self-aligning technique reduces transistor size.

When bipolar transistors are fabricated by extensions of conventional CMOS processes, it generally takes more process steps to fabricate them and they are inferior because of higher collector series resistance, larger base width, and larger size. Moreover, when n-type substrates are used, npn devices then have a common collector connection rather than being isolated from each other.

When MOS FETs are fabricated by conventional bipolar processes, they usually have poor characteristics because of thick gate oxide. Also, conventional MOS-FET fabrication processes are not suitable for the fabrication of $I^2L$ circuits or pnp transistors.

**High voltage.** Yoshitaka Sugawara and his co-workers at Hitachi's Research Laboratory in Hitachi City are developing high-voltage lateral pnp transistors with a new configuration for linear ICs. These devices are for systems requiring complementary output circuits, including vertical-deflection-output ICs for color TVs and SLICs for telephone time-division exchanges.

Improved lateral transistors compatible with npn transistor processing are required for these applications because those heretofore available have poor characteristics. The tradeoff between collector-to-emitter breakdown voltage $BV_{ceo}$ and gain-bandwidth frequency $f_t$ has prevented the design of high-voltage devices for high-speed operation. Vertical pnp transistors have desirable characteristics, but they are prohibitively complex to fabricate on the wafer.

The new transistor configuration features a p-type emitter diffused through the same photoetched silicon dioxide window as the n-type base (see figure, p. 22). These two diffusions define the base-to-emitter junction of the narrow base needed for high gain-bandwidth frequency $f_t$ and high current gain $h_{fe}$. Hitachi engineers thus call the new device the self-aligned double-diffused lateral (SADDL) transistor. To implement a simple fabrication process, the emitter diffusion uses the same boron diffusion as the p-type base of the vertical npn transitors.

To define the base-to-collector junction of the narrow base and maintain a high collector-to-emitter breakdown voltage $BV_{ceo}$, a lightly doped p-type layer is diffused between the collector contact diffusion and the double-diffused base. Because this diffusion acts as the collector over the normal range of operating voltages, its surface impurity concentration and depth are optimized.

The tradeoff between $f_t$ and $BV_{ceo}$ for this design is improved by a factor exceeding 100 times compared with conventional lateral pnp transistors that rely on a wide base width only to achieve high collector-to-emitter breakdown voltage. The tradeoff is improved by a factor of more than 10 compared with modified transistors that utilize a lightly doped p-type layer to extend the collector but do not have the double-diffused base.

SADDL transistors designed for a $BV_{ceo}$ of 350 V have a high current gain $h_{fe}$ of about 100 and a high gain-bandwidth product $f_t$ of about 15 MHz. They are isolated from each other and from other devices on the same chip by the so-called EPIC isolation process, in which the devices are fabricated in epitaxial wells that are dielectrically isolated from each other by a layer of silicon

## Computer's architecture assigns processes

**Portland, Ore.**—Multiprocessor computer systems typically suffer from one or more bottlenecks when they share processing power, memory, and system input/output facilities. Now Sequent Computer Systems Inc. claims to have eliminated most of these bottlenecks with a radically new architecture that assigns resources to processes, rather than to processors. The result, Sequent says, is a linear increase in performance as additional processors are plugged in—up to a dozen in one system.

This week, Sequent, a 1983 spinoff from Intel Corp., Santa Clara, Calif., announced its Balance 8000 system, which consists of an array of National Semiconductor Corp. 32-bit 32032 processors connected by a proprietary bus and includes a proprietary gate array chip that allows processing power to go where it is needed. The chip, called a system link and interrupt controller, contains 64 bits of system memory relating to resource allocation.

Each processor has a controller, each of which is connected on a two-wire serial bus. Before a processor asks for access to a resource, it checks its controller to see if the resource is free. Only if the appropriate bit is set does it issue a request over the 40-megabyte system bus. In effect, the controller offloads bus traffic to provide semaphores and an interlock mechanism.

The controller, built by LSI Logic Corp., Milpitas, Calif., makes it possible for the system to operate with a single copy of the AT&T Bell Laboratories Unix operating system in memory. (Sequent has provided its own version of Berkeley 4.2 Unix for the National chip. Any single-processor Unix application will run on the Balance system, Sequent says.) The system link and interrupt controller handles interrupts and will configure the system automatically, utilizing as many processors as are plugged into the bus.

Original-equipment manufacturers can tailor a system capable of 2 to 7 million instructions per second. Additional processor boards—each containing two 32032s, with associated memory-management and floating-point chips, as well as two controllers—can be plugged in at will. The controller architecture allows the system to operate regardless of which microprocessor is being utilized by any given process. In fact, says Sequent, some processes may utilize two or more processors. System overhead is distributed over all processors, and if one processor fails, the system goes down and instantly reconfigures itself. A two-processor system, the company says, provides the equivalent of VAX 780 performance and costs about $41,500 in OEM quantities. A complete 12-processor system sells for $110,000. **–Clifford Barney**

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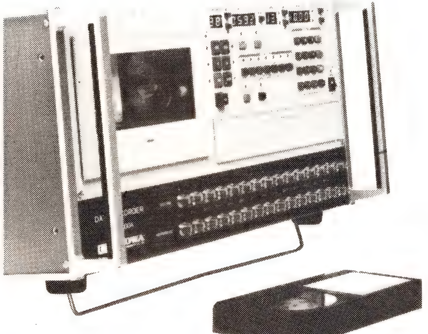

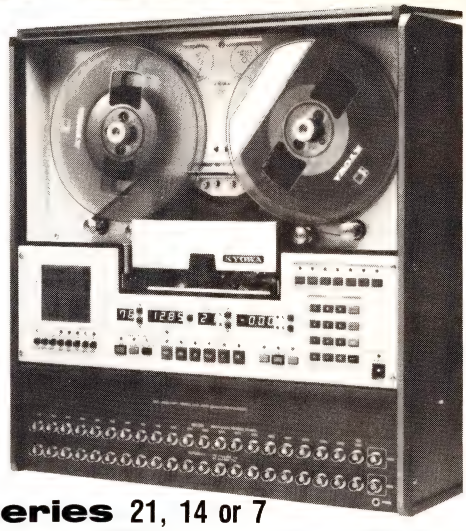

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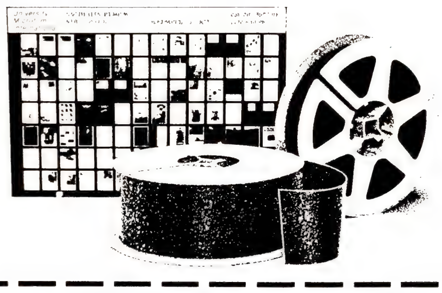

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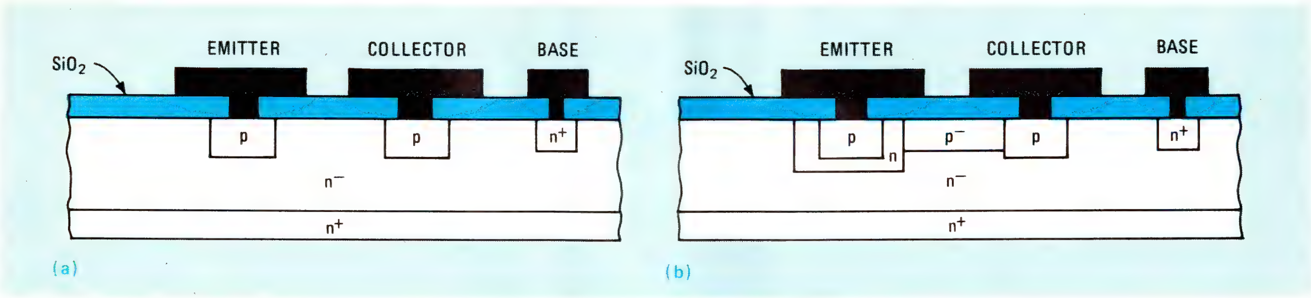


**Lateral move.** Conventional lateral pnp transistors designed for high breakdown voltage (a) need widely spaced emitter and collector diffusions for low frequency response and low current gain. SADDL pnp transistors (b) have a narrow base region for high-speed operation and high gain.

dioxide. This method is more expensive than conventional p-n junction-isolation processes but is used because it is the only available method of polarity-independent high-voltage isolation.

Masatoshi Kimura and his co-workers at Hitachi's Central Research Laboratory have designed monolithic ICs that combine 150 V totem-pole drivers and high-speed logic circuits for use in driving plasma, electroluminescent, or vacuum fluorescent displays. Experimental devices that integrate eight driver circuits have been fabricated, but initial commercial circuits will have 32 drivers. **–Charles L. Cohen**

## DISK DRIVES

# Manufacturers cooperate to develop a faster next-generation interface

**Minneapolis**—Four major manufacturers of high-density disk drives are joining hands with a controller manufacturer in an attempt to assure a smooth transition to a standard interface for the next generation of disk drives. Called the Parallel Device Interface by its developer, Control Data Corp., PDI is based on levels 1 and 2 of the Intelligent Peripheral Interface (IPI) standard under development by the American National Standards Institute.

Control Data, of Minneapolis, is one of the four drive makers pledged to provide funding to Emulex Corp., a Costa Mesa, Calif., controller maker. The money will be used by Emulex to develop a very large-scale integrated-circuit set that can be used by drive makers to implement PDI, once its final form is agreed upon.

Besides CDC, other members of the "IPI-2 club," as it is called by one official involved, include Fujitsu America Inc., San Jose, Calif.; Century Data Systems, Anaheim, Calif.; and Priam Corp., San Jose.

Emulex is operating as a go-between to resolve any objections to the CDC-written PDI specification from other drive vendors, "so that we'll wind up with a VLSI chip set that everyone will use," explains Patrick E. McMahon, general manager for market requirements for Control Data's Peripheral Products Co. The total funding requirement for the chip-design effort is pegged at about $500,000.

Emulex is looking for at least one more drive maker to help fund the effort, says Stephen G. Finch, director of software products for the firm. In fact, "it's wide open to everybody," points out Dal Allan, Priam's marketing product manager. "This is not an exclusive club. Participation requires only desire and dollars." Like other backers of the effort, Allan sees agreement as a way to avoid the interface wars that have confused users and slowed market entry of some earlier drive products.

Design is underway on the PDI two-chip set for fabrication in 3-$\mu$m complementary-MOS gate array or standard cell technology, sources indicate. The ICs are expected to be available from one or more silicon foundries. The first pass in silicon is anticipated early next year.

Control Data, for one, expects to offer small quantities of disk drive products equipped with a breadboard version of the PDI circuitry during the first quarter of 1985 and plans to begin shipping drives using the ICs by the second or third quarter, says McMahon. CDC's 850-megabyte XMD drive will likely be the first to use the chips. Priam will be on a similar schedule with its 500-megabyte Priam 808 drive, Allan says.

At Fujitsu, the product manager for high-capacity disk drives, Michael J. Gamerl, is quick to point out that his firm has not necessarily committed itself to using the Emulex-designed chips. But he does note that Fujitsu "is going to incorporate IPI level 2 in future products."

**Segmented.** The IPI standard is broken into three levels. IPI-1 covers the physical interface such as cable and connector types that may be selected. Level 2 deals with device-specific command sets. Drafts of the first two levels have been recently sent out for public comment, says Priam's Allan, who is also vice chairman for the X3T9.3 subcommittee that is developing the standard. A draft version of IPI-3, which covers logical level command sets for a truly intelligent, or device-generic interface, has been recommended to the X3T9 parent committee for a vote on its public readiness.

As disk-drive densities climb higher, the technology has lately been bumping the limits of the current industry standard, the two-cable, serial Storage Module Drive (SMD) interface. "Right now, the interface is slowing down the disk technology," complains one official at AT&T Bell Laboratories, in Naperville, Ill.

By using fast emitter-coupled-logic drivers and receivers, among other things, vendors have extended the speed of the SMD interface from about 10 mb/s to the 24-mb/s rates at which today's fastest drives transfer data. But as disk-drive technology advances, even faster transfer rates will necessitate a parallel interface like IPI, which provides for a 16-bit-wide cable.

"It'll be a year or two before PDI is even implemented in high volume," says James W. Patton, Control Data's product requirement manager for magnetic disks. "But IPI-2 is the tool that allows us to break through the serial roadblock."

Frank Casserino, director of peripheral product planning at Honeywell Information Systems, in Waltham, Mass., applauds the far-sightedness of the IPI standards-making committee. He also lauds the cooperative approach being taken by the four drive vendors, which he sees as an example of a "new culture" of increased cooperation in U.S. electronics industry.

"The one unique thing about this is that there will be chips to drive the interface from the beginning," Casserino says. **–Wesley R. Iversen**

## BUSINESS

# U.S. firms seek harmony in Japan

**San Francisco—**Looking at U.S.-Japanese business from a distance, the casual observer might think the culture and trade methods of the two lands are pretty much the same. But that just isn't so, say many insiders here who are responsible for the success of these trans-Pacific business and technology interchanges. In fact, one informed judgment holds that the status of the touchiest part of U.S.-Japanese connections—the preliminary negotiating process leading to a deal—is more confusing than ever.

The major source of miscommunication comes from small U.S. companies crowding into the Japanese market without knowing how the cultural differences will affect them, says Hal G. Nielsen, a veteran Japanese hand with some 19 years' experience there. Nielsen argues that even some major firms have forgotten lessons that they learned in earlier negotiations, largely because key executives move on.

To bridge the gap, Nielsen now runs the San Francisco-based Entry Group International, which counsels U.S. firms on Japanese markets. He has also conducted nearly a dozen American Electronics Association seminars on the subject.

According to Nielsen, a basic pitfall awaiting a U.S. firm is the totally different Japanese view of negotiations and any subsequent deal the two parties may strike. For the Japanese, "negotiations are an end in themselves, leading to a flexible lasting relationship, not necessarily culminating in a formal legal document," he says.

**Disillusionment.** Conflict is inevitable when a U.S. delegation arrives in Tokyo and hopes to quickly negotiate a contract that specifically defines rights and duties of both parties. "It's no wonder so many go home with nothing to show other than an expensive business deduction," Nielsen says.

He says that two factors most often trip up U.S. firms, even those that have something attractive for the Japanese market. For one, the Japanese simply do not apply the time-is-money concept; they take as much time as they need. A Japanese firm has its own pace that cannot be hurried and usually spends a great deal more time on nonbusiness "getting-to-know-you" sessions than Americans do.

Another is the Japanese insistence on preparation. U.S. businesspeople, by contrast, usually do not have enough information in their heads to satisfy the meticulous Japanese approach to any subject that requires voluminous data; they keep telexing back home for more. "I have one negotiation that has gone on for five months," notes Nielsen.

A better-known Japanese attribute is distaste for confrontation and an aversion to using lawyers. "If disputes arise, the Japanese tend to compromise, not litigate. They turn to the law very reluctantly," he says.

Because the business potential for both sides keeps growing, Nielsen is experiencing a brisk demand for his services of advising clients how to deal with the cultural and historical differences between the two countries. Besides the $2.19 billion of goods sold to them in 1983, Japan is taking steps to make it easier for U.S. firms to export, after pressure from the American government. For example, U.S. telecommunication firms are bidding on contracts—estimated at $3.2 billion—to be awarded by Nippon Telegraph & Telephone Public Corp. **–Larry Waller**

### Doing as the Japanese do

Among U.S. firms doing business in Japan, Hewlett-Packard Co., Palo Alto, Calif., "is light-years ahead of the rest" in dealing with the historical and cultural gap, according to consultant Hal G. Nielsen. The firm understands that any relationships will be long-term, he says—an approach borne out by the successes of Alan Bickell, vice president and managing director of intercontinental operations.

HP's joint venture, Yokogawa Hewlett-Packard Ltd., dates back to 1965, and its all-Japanese management has been continuous. "We've grown up with each other," notes Bickell, who has worked with them for 18 years. Even so, "It's not always perfect every time; we have to think about the culture gap continually," he says. Taking great pains to ensure communication, often summing up all talks in writing, is the key. Also, Bickell is now in Japan, on his fifth trip this year.

Firms with shorter records have also come up with ways to bridge the gap. Tandem Computers Inc., Cupertino, Calif., has added a new post in the last year at its four-year-old subsidiary, says Gerald L. Peterson, vice president for international marketing. "The post has to be filled by a U.S.-born person who speaks Japanese and is steeped in Japanese history and culture," he says. The title will be "adviser," more prestigious in Japan than in the U.S. "He facilitates communication at all levels," says Peterson. **–L.W.**

# Shortage of compilers slows Ada, but help is on the way as second wave of firms gets to work on new packages

**If Ada were** a train, there are those who would say it's running late. But others would say that, although it's slow, the Ada train is right on schedule. And then they would point down the track and say, "Look, you can see it coming now."

What the optimists anticipate is that potential Ada users will soon be offered more compilers, a shortage of which has slowed implementation of the Department of Defense's programming language. Though four years have passed since the DOD established Ada as a standard, the language has only three validated compilers, and there is little enthusiasm about their quality.

But that appears about to change. "A year ago, I speculated we'd end the year with 10 validated compilers—and we're on schedule," says Robert Mathis, director of the government's Ada Joint Project Office.

Most prominent is a compiler from Digital Equipment Corp., Maynard, Mass., which now is awaiting results of its validation testing. Charles Wetherell, who supervises a group developing a compiler for AT&T Bell Laboratories in Summit, N.J., thinks many others will soon follow. "The second wave of compilers will come out faster than the first," says Wetherell, who expects most of them to hit the market within the next year or two. He also says the new compilers will be faster and of better quality than the ones developed thus far.

**Military language.** Ada is part of a DOD initiative to hold down rapidly escalating software costs by reducing the number of programming languages in use in the military and by developing a language suited both to defense needs and to modern programming methodologies. Its proponents tout its facility for parallel and real-time programming, its package features, and its ability to do consistency checking. Not only will Ada go a long way toward solving DOD's problems, say its most ardent advocates, but in the long run the language will make strong inroads into the commercial sector.

But that requires production-quality compilers. At this stage, the only DOD-validated compilers are the Telesoft Compiler, the Rolm Ada Compiler marketed by Data General Corp., Westboro, Mass., and the NYU Ada/ED compiler from New York University's Courant Institute (see table).

"So far, none of these are very good compilers," claims Gerald Fisher, chairman of the Association for Computing Machinery's Special Interest Group on Ada. Not only are they slow, but they produce poorly optimized code. Fisher says the first compilers took a long time to build, partly because the language standard was still changing. "But even now, it would still take two years at a minimum [starting from scratch] to get an Ada compiler built."

**Many features.** One of the people investing that time is Michael Ballentine, president of Software Leverage Inc., in Arlington, Mass. He says part of the difficulty in building a compiler is that Ada is a very complicated language and incorporates many features that compiler writers haven't seen before. "Ada has an awful lot of problems, all of which are solvable," he says, but those solutions take time.

Another reason development has been slow is that Ada compilers do a lot more than compilers for other languages, such as their ability to do consistency checking, says Chuck Patrick of Alsys Inc. in Waltham, Mass. In addition, Ada faces special demands, because many applications will be in embedded systems.

Such systems require that compilers be highly optimized, says Michael Ryer, director of the Ada Systems Division for Intermetrics Inc., Cambridge, Mass. "You can't just add boards" for storing the extra code, he says, adding that these applications also demand the highest degree of reliability.

**Complexity.** Ryer agrees that Ada is very complicated and that this slows the building of compilers. But he says its complexity is different from that of some other languages. PL/1 "was also very complex, but complex like a shopping list rather than like a watch. PL/1 has a huge assortment of unrelated features. Ada's complexity is more in the interaction among features."

Ryer says Intermetrics is working on several major compilers under contract to the Air Force and that the products "will absolutely be of production quality." Also working under contract to the military is SofTech Inc., of Waltham, which is developing the Ada Language System for the Army, as well as retargeting the system for the Navy's computers. Jorge Rodriguez, SofTech senior vice president, says the company has written over 500,000 lines of code for the system.

"We expect validation before this

ADA COMPILERS VALIDATED BY THE DEPARTMENT OF DEFENSE

| Company | Compiler | Host and target machine |
|---|---|---|
| Telesoft Inc. | Telesoft Compiler version 2.0al | 0-bus Motorola 68000 |
| Rolm Corp. and Data General Corp. | Rolm Ada Compiler version 5.234 | Data General MV4000, MV6000, MV8000, MV8000-II, MV10000, Rolm MSE-800 |
| New York University, Courant Institute | NYU Ada/ED version 1.4 | Digital Equipment Corp. VAX 11/780 |

SOURCE: ADA INFORMATION CLEARINGHOUSE, ADA JOINT PROGRAM OFFICE fall," says Rodriguez, adding the Ada system will cost about $50,000. "The compiler we're developing will be the first one to produce code that is production quality."

Rodriguez would get some argument about that claim from the people at Data General, which says the compiler it is already marketing is production quality. Lee Erhlichman, of the Ada marketing group, says some of the early sales have been to nondefense-related businesses.

The French company Informatique Internationale, for example, bought one of the Data General compilers and is using Ada in the modeling and specifications stage of designing a large electronic funds-transfer network. Erhlichman says other commercial customers of Data General's Ada Development Environment, which includes the compiler and other tools for a price of $84,000, decline to be named because they think the product gives them a competitive edge.

Most observers, however, speculate that Ada will find only limited early acceptance outside the defense work where it is required. "I don't think it will catch on soon in commercial data processing," says Ryer of Intermetrics. "There's too much Cobol momentum." But many of those working on Ada do see a long-term future for the language in certain commercial applications. In the area of embedded systems, says Ryer, Ada is likely to be used commercially just as in military applications, because it "doesn't matter whether the black box is in a guided missile or a washing machine."

**Dumb mistakes.** Ada's ability to do consistency checking will also make it attractive for use in large projects. "People who have projects with 10 to 100 programmers working for a year are going to look real hard at Ada, because Ada makes a lot of errors literally impossible," says Wetherell of Bell Labs. He adds that in one Bell project study, about 25% of the errors could be laid to "stupid programming mistakes. Ada would have caught half of these."

But Wetherell is cautious about whether Ada's modularity and the DOD's intention to create libraries of reusable code will dramatically reduce the amount of code written by programmers. "Put me down as a skeptic. I don't think there will be an epiphany in the way people work."

In addition to DEC, SofTech, Alsys, and Intermetrics, other groups moving close to validation include Dansk Datamatik Center of Denmark, Karlsruhe University of West Germany, Verdex Corp. of McLean, Va., and Tartan Laboratories in Pittsburgh. In total, the implementation list published by the ACM lists 39 Ada projects. –**Craig D. Rose**

## CONSUMER

# Multifunction security systems are borrowing telecom technology

**New York**—The technology of security—that is, efforts to maintain the safety of both life and property—is merging with the technology of telecommunications. The consensus among exhibitors at the International Security Conference held here in late August was that deadbolt locks, light timers, and the like are no longer adequate to fully protect homes and businesses.

Of course, the concept of security itself has been expanded to include smoke and fire detection, safeguarding the integrity of confidential data, and remote paging of a physician or ambulance in the event of a medical emergency. All of these requirements depend on electronic signal transmission, so it was not surprising that many of the new manufacturers of security equipment have their personal and corporate roots in the telecommunications industry.

One such company is TeleSecurity Inc. of Dallas, whose president, G.R. Miller, began his career with another Dallas firm, U.S. Telephone Inc., in New York. He says he now seeks to "initiate a successful marriage between two of the fastest growing industries today."

TeleSecurity's entry into the security market is called the Protector, a system that works both locally and over a standard telephone network. A module on the user's premises senses motion ultrasonically and uses infrared technology to pick up body heat. An integrated microprocessor runs an interrogation routine based on preprogrammed sound and heat parameters to determine if a break-in has occurred. Miller explains that the use of two detection modes prevents false alarms, since different conditions must be met before an abnormal situation will register.

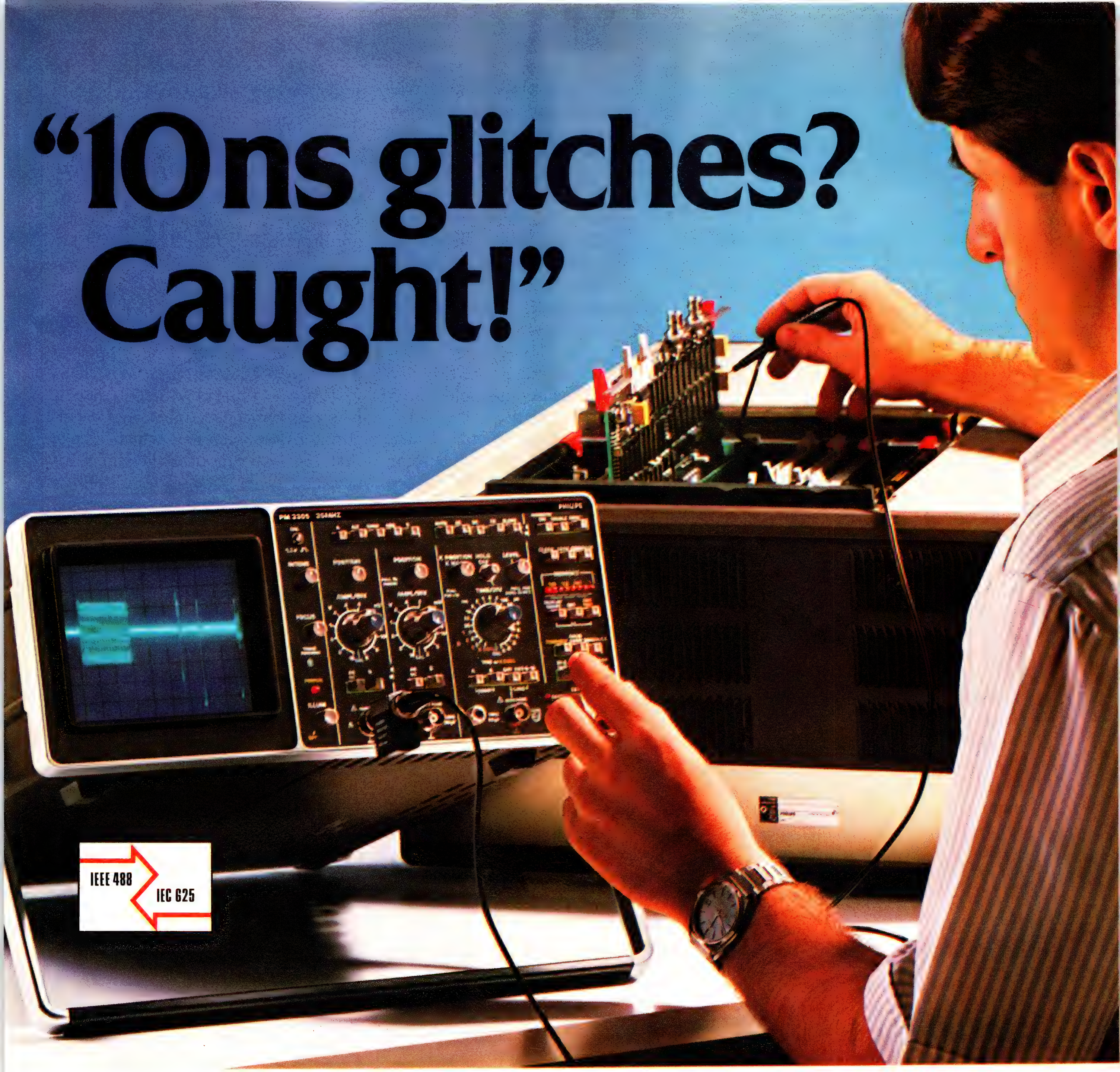
If an intrusion occurs, the module sounds a 120-dB alarm and flashes a strobe light that is "guaranteed to scare hell out of a bad guy in a dark house," says Miller. Then the rest of the system goes into action.

If the entry does indeed prove to be an unauthorized one, the on-premises control panel immediately telephones the firm's mainframe computer in TeleSecurity's control center in Dallas. The computer system, in turn, notifies the appropriate local police department. If there is a fire—detected by a separate, photoelectric module—the fire department is contacted. A user can also report a medical emergency by pressing the appropriate button on the panel.

The system's computer is a Stratus 32 made by Stratus Computer Inc. of Natick, Mass. It contains over 1.6 gigabytes of disk storage, which the firm says translates into the capacity to service 1 million subscribers anywhere in North America.

**Multifunction.** In addition to the tasks directly related to security, the control panel can perform other telecommunications activities. Not the least of these is simply acting as a programmable tone-key telephone for normal use.

Miller claims that the panel represents a "quantum leap forward" in communications management, because it uses a pulsed, wireless 306-MHz radio-frequency signal (versus a nonpulsed wire-carried signal) to accommodate the up to 4,000 instructions per second used to control the security system, normal telephoning, and any other type of home appliance—for example, a coffee maker



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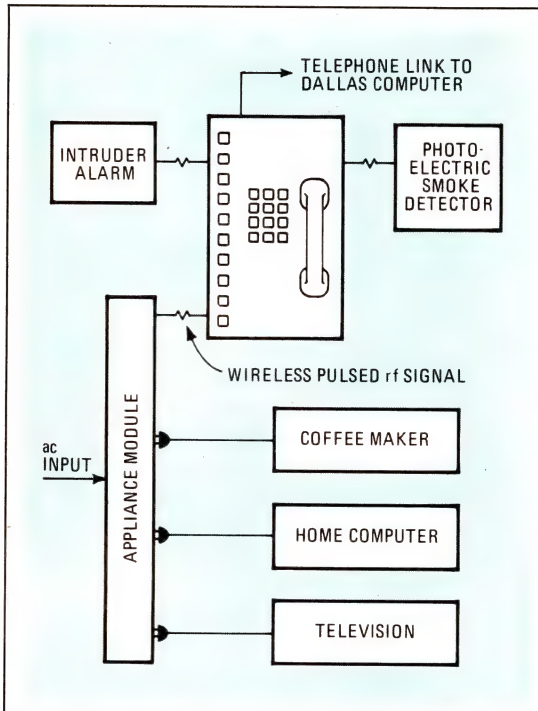
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**Phone-line link.** Modules for intrusion and fire detection, and for other appliances, are radio-linked to a central panel, which also functions as a telephone.

or video cassette recorder—which can be connected with normal ac plug-in modules. Also, says Miller, the system is not affected by other rf sources, and its pulsed codes make it virtually jam-proof.

**Lease only.** A homeowner can lease the Protector for 36 months at a cost of about $25 per month, including the subscription service to the Dallas center. A small business would pay $30 per month and also get the use of a link and built-in modem for encrypted data.

TeleSecurity intends to market its products internationally, because the social forces that militate for greater security are not confined to the U.S. Whether they will continue to be tied into the Dallas computer after that is still to be decided.

Others share the Dallas company's view. According to Joe Olmstead of Colorado Electro-Optics in Boulder, Colo., "International sales represent about 15% of U.S. manufacturers' production. The European market is seeing growth similar to that of the U.S. three years ago. The world-wide security market is also becoming more competitive.

"We're seeing more imports now—mostly from Japan—because the dollar is strong, and because Japanese technology has security applications." As examples, he cites fiber optics and seismic-shock detectors, which can be used, respectively, to safeguard data transmissions, and for intrusion detection.–**David M. Weber**

## MICROSYSTEMS

# Sporting new ideas and architecture, the 8-bit bus is starting to catch on

**London**—Even though it may be out of the limelight, the 8-bit market is continuing to show it can spawn new ideas and architectures. One example is the Standard Bus on Eurocard (STE), now just a rubber stamp away from final approval as a standard by the Institute of Electrical and Electronics Engineers P.1000 committee.

Its official adoption is some six months away. But that's not worrying a nucleus of half a dozen adventurous manufacturers, who are already introducing backplanes, processor and memory boards, and all the other building blocks needed to assemble off-the-shelf systems (see "STE bus suppliers jump the gun," p. 36)

The Eurocard mechanical format, on which the STE bus is based, is widely used throughout Europe and has increasingly been adopted in new IEEE bus standards. The VMEbus, Multibus II, and Futurebus all feature the rugged two-part connector and rigidly defined mechanical specifications that make the Eurocard system so popular. But a corresponding electrical specification for an 8-bit processor standard has been long in coming.

As a result, "there are at least 50 single-Eurocard buses on the market," says Bob Squirrel, manager, Systems Division, Dage Systems Ltd., Aylesbury, Bucks., UK. "Many are proprietary, and the majority are simply dedicated to a single processor family. STE brings not only standardization but also a leap in performance." For example, the bus is designed from the outset to support a large 1-Mb address space as well as to support multiprocessing. Also, it is processor independent and asynchronous in operation, which means that the bus can take advantage of new and faster processors as well as input/output devices as these come along.

Since the STE standard is processor independent, different manufacturers' processor boards will work together. At least that is the idea, but as a latecomer to the marketplace with only small independent manufacturers to back it, STE may lack the muscle to seriously challenge established 8-bit bus standards such as STD, which was designed by ProLog Corp., Monterey, Calif., and introduced with help from Mostek Corp. of Carrollton, Texas, in 1978.

The STD bus is now supported by over 150 board manufacturers. Thus, even if the STE standard does become a major force in Europe, it might take longer to establish itself in the U.S.

In fact, the STE bus has done well just in gaining IEEE recognition, a feat it achieved by riding on the coattails of the bigger, and vastly more ambitious, IEEE Futurebus standardization effort for a 32-bit asynchronous bus. The basic idea, a Eurocard version of the STD bus, was first proposed by Tim Ellsmore, then with the small London outfit, GMT Electronic Systems Ltd. and now with Seaport Computer Systems, Inc., San Diego, Calif., where he is vice president in charge of STE development.

Paul L. Borrill, a researcher at the Mullard Space Science Laboratory, Dorking, Surrey, UK, and chairman of the IEEE P896 Futurebus working group, picked up the idea, and for a while it was considered as a low-cost version of Futurebus—both operate asynchronously. But this

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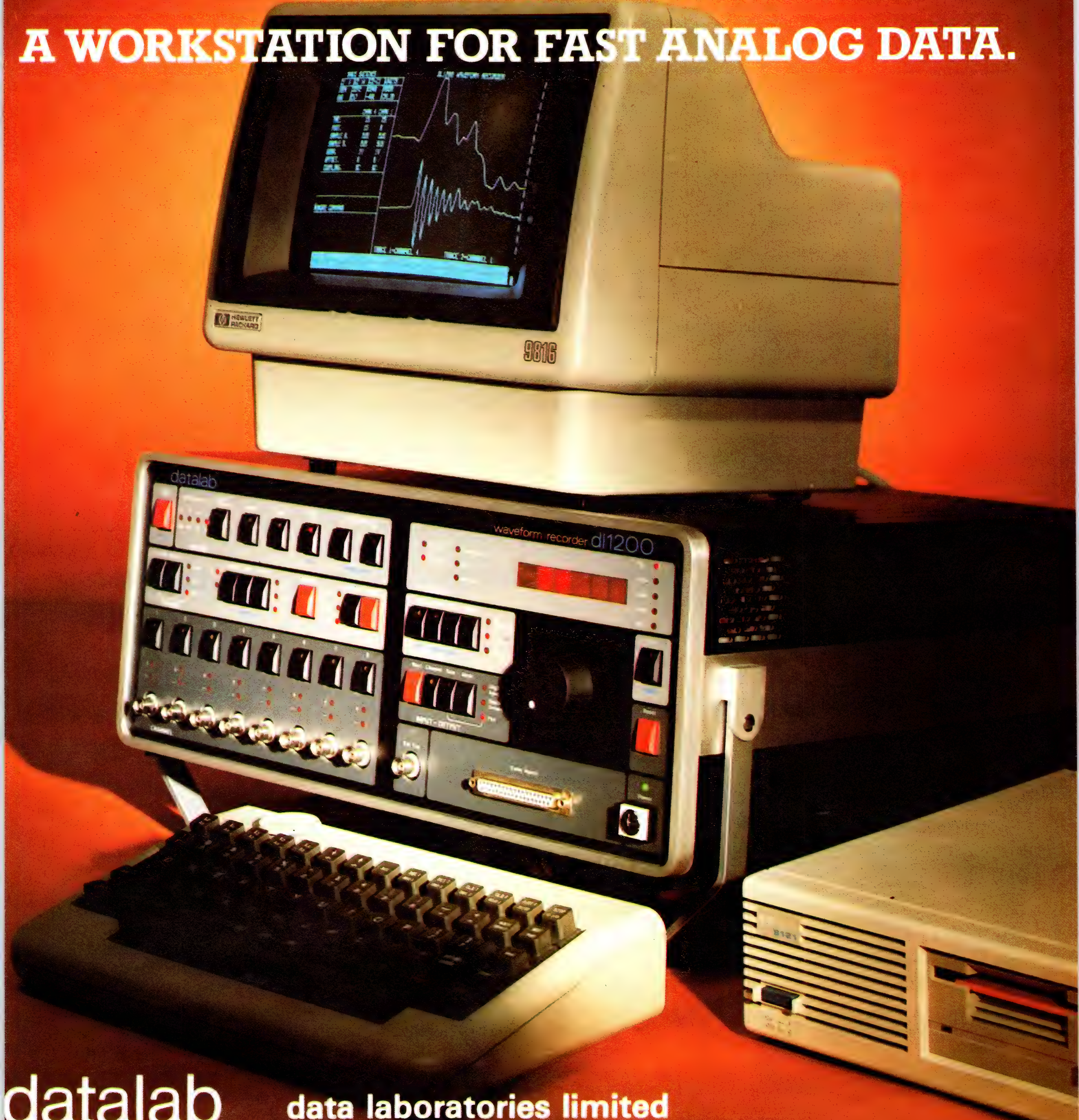

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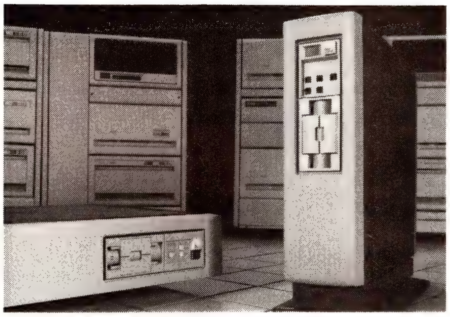

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## STE bus suppliers jump the gun

A few board manufacturers that feel the odds are with them are introducing a range of products in anticipation of the IEEE's 8-bit bus standard ratification. Before year-end, systems houses could begin to assemble systems using three different types of architecture. Most of the action is in Great Britain, although Seaport Computers Inc. in San Diego expects to be one of the first companies to get into the U.S. market with board subsystems, along with J.F. Micro Corp., Pasco, Wash.

Arcom Control Systems Ltd. of Cambridge, UK, has a Z80-based computer system, complete with 3-in. floppy disk drives, 64- or 128-K random-access memory board, parallel input/output facilities, and an 8-bit analog input board. GMT Electronic Systems Ltd., in London, is kicking off with 10 STE cards, including a complementary-MOS NSC800 microprocessor, 68008 or 6809 processors, memory modules, a programmable parallel I/O board and multifunction utility card with RS-232-C interface.

The Del-Tech Ltd. consultancy in Stockport, Cheshire, is also coming out with a Z80 processor card, dynamic and static RAM boards, floppy disk, and IEEE-488 controllers. Meanwhile, Dage Systems Ltd. in Aylesbury, Bucks., UK, is in production with a range of four-layer backplanes. **–K.S.**

proved impractical as it would add too much to the cost, so a new bus standardization initiative got under way.

Foremost among these was developing a standard incorporating processor independence, one whose prescribed signal-bus tolerances would cover most processor clock speeds and signals. The result was STE, which uses an asynchronous bus that allows any input/output board to work with any processor board, even if they use a different clock rate.

STE is designed for both standalone and multiprocessor operation, and can support up to three bus masters. There are eight prioritized interrupt levels and a system-error signal. The STE system has 20 address lines—compared with the 16 found in many other systems—and can be used to address up to 1 megabyte of memory. **–Kevin Smith**

## SENSORS

# With radar-like ranging technique, robots can see in three dimensions

**Karlsruhe, West Germany**—Though it is still a long way from emulating the human vision process, a German-developed visual sensing system that sees objects in three dimensions takes sensor technology another step toward its ultimate goal: a substitute for the human senses. Duplicating such facilities as vision, hearing, and touch would make for robots with more human-like abilities, conceivably leading to a totally automated, workerless factory.

The system is a joint development of the Fraunhofer Institut für Physikalische Messtechnik (IPM) in Freiburg and the Energy and Automation Division of Siemens AG in Karlsruhe. It uses radar-like ranging techniques to produce a 3-d image of an object not only in the X-Y plane but also with height information—that is, on the object's different levels above the ground plane.

The system feeds digital picture data—information on the object's position in terms of its X, Y, and Z axes, and its tilt and turn angles—to a computer or robot. The robot uses the data to identify the object and position its arm to grab the part whose image data matches that stored in a program.

The 3-d optical ranging system is

the brainchild of IPM, which did most of the development work. Siemens helped in making a prototype, with financial support from Bonn's Ministry for Research and Technology. Siemens will use the system in the automation equipment it manufactures. Systems for tests in industrial environments and under operating conditions will appear next year.

Peter Wurll, head of the sensor development group here, points to two potential uses for the system: alongside parts conveyors and in pick-and-place robots. In a stationary position next to a belt transporting automotive parts, for example, the system will recognize the parts by their shapes. The parts need not be neatly arranged on the belt—they can even partly cover each other. Enough information for positive identification can be extracted from the uncovered areas for material flow control or sorting operations.

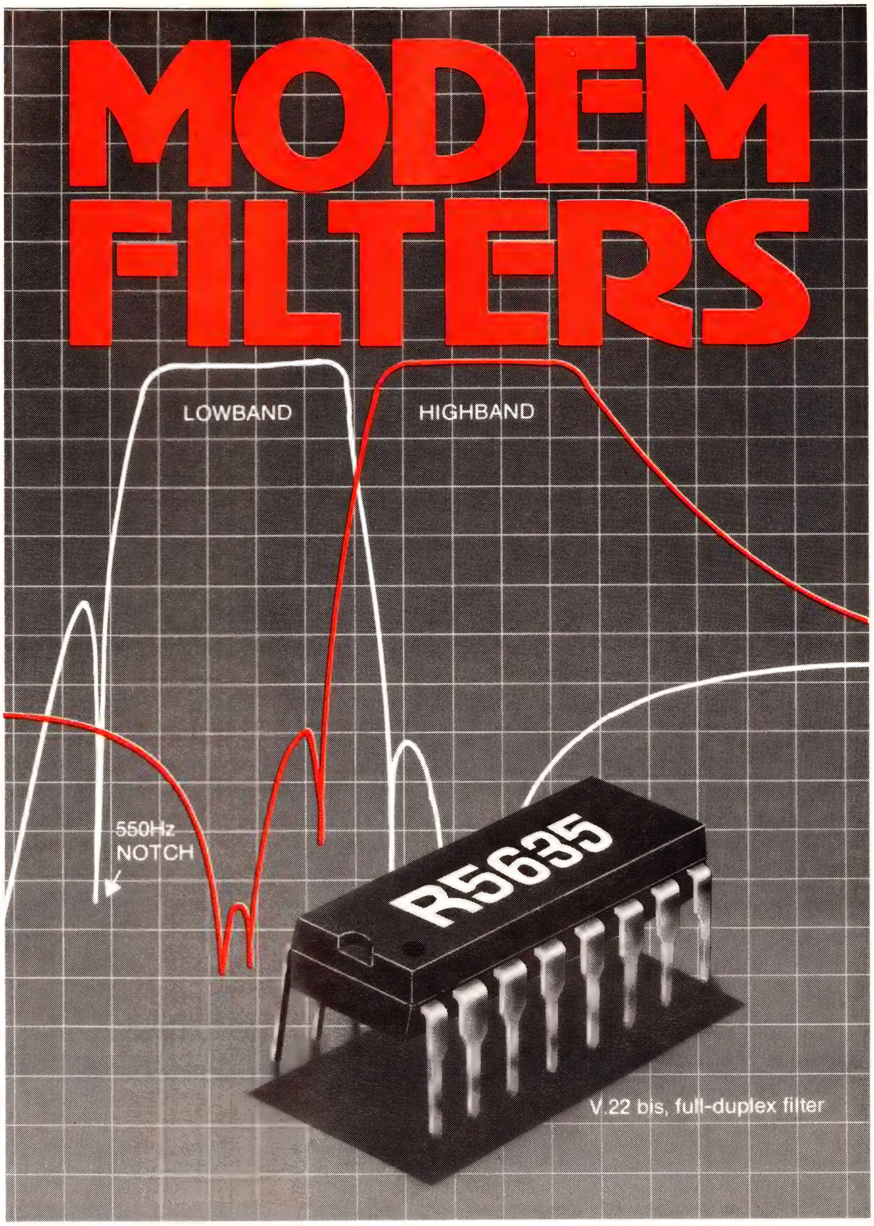
In a pick-and-place application, such a system can help a robot select randomly arranged parts of different shapes. The robot will pick them up and place them in neat order elsewhere according to their shapes.

It takes the system about 1 s to identify a 3-d object. "By optimizing certain subsystems, we think we can cut that time in half," Wurll says.

An alternative method to optical ranging, Wurll notes, is stereophotography using several cameras. Such methods, however, have not yet been used in a practical system. "Besides, in contrast to the principles we use, stereophotography should prove an uneconomical solution to implement 3-d object identification."

**Diode controls.** Central to the IPM/Siemens system is a gallium arsenide laser diode controlled by a high-frequency-signal generator. The diode emits a harmonically modulated beam of infrared light, with a lens-and-mirror arrangement that focuses the light onto the object to be identified. The signal generator operates at about 433 MHz, a value the designers found convenient because it conforms to the operating parameters of other system components. Then, too, a high frequency ensures high resolution.

The diffuse light reflected from the object is focused, also through a mirror-and-lens arrangement, onto a detector. The latter converts the light



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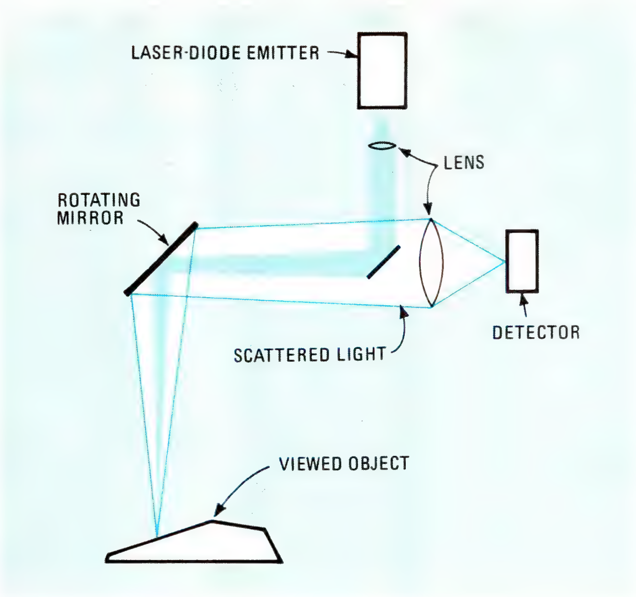


**Light look.** By illuminating objects with a laser beam and then directing the reflection to a detector by means of a rotating mirror, Siemens generates 3-d images for factory robots.

into a high-frequency electrical signal that varies according to fluctuations in intensity.

The phase difference between the incoming and the modulated signals is a measure of the laser light's propagation time. Consequently, it is also a measure of the height—the various levels—of the reflecting surfaces relative to a reference plane.

The laser beam is deflected across the object in two directions so that the picture-processing system produces an array of image points. The point array's different intensities indicate the object's different heights or levels. Height information plus data on the object's position in terms of the X, Y, and Z axes as well as the tilt and angular position are fed through an RS-232-C interface to the computer or robot.

If the array points are converted to analog information and fed to a color monitor, the object level nearest to the system shows up as a white area and the level furthest away from it as a dark area. Intermediate levels appear in different colors. With the system located 2 m above the object plane and with the object measuring roughly 50 by 50 by 50 cm, an axial and lateral resolution of about 2 mm is achieved. The number of pixels over the object area is 256 by 256; each pixel has an 8-bit resolution.

The optical ranging system is thus an application of modulated-beam optics combined with the methods of high-frequency technology. In the longitudinal direction, the light beam has the characteristics of high-frequency radio waves but, unlike radio waves, it is highly concentrated in the transverse direction.

Optical radiation produces a diffuse reflection that can be evaluated as an echo off all surfaces of a solid body. Differences in distance are determined by continuous harmonic-periodic intensity modulation of the beam and subsequent phase comparison with a reference signal. This enables the radar ranging method to be used on a small scale. **–John Gosch**

## REGIONS

# Expanding firms are flocking to North Carolina, but start-ups elude state's efforts to draw them

**Research Triangle Park, N.C.**—In 1979, General Electric Co. was evaluating potential sites for a new $55 million microelectronics research and manufacturing facility. The firm thought this 5,800-acre tract carved out of a lush pine tree forest looked exceedingly attractive. But there was one hitch: the area had no national-level semiconductor activity from which GE could recruit talent.

Not about to let a such major league high-tech player get away, the state's aggressive governor, James Hunt, asked GE what it would need to chose Research Triangle Park for its facility. GE's answer gave birth this past June to the $43 million, state-funded Microelectronics Center of North Carolina. Having set up its own microelectronics research center here two years earlier, GE became MCNC's first corporate affiliate.

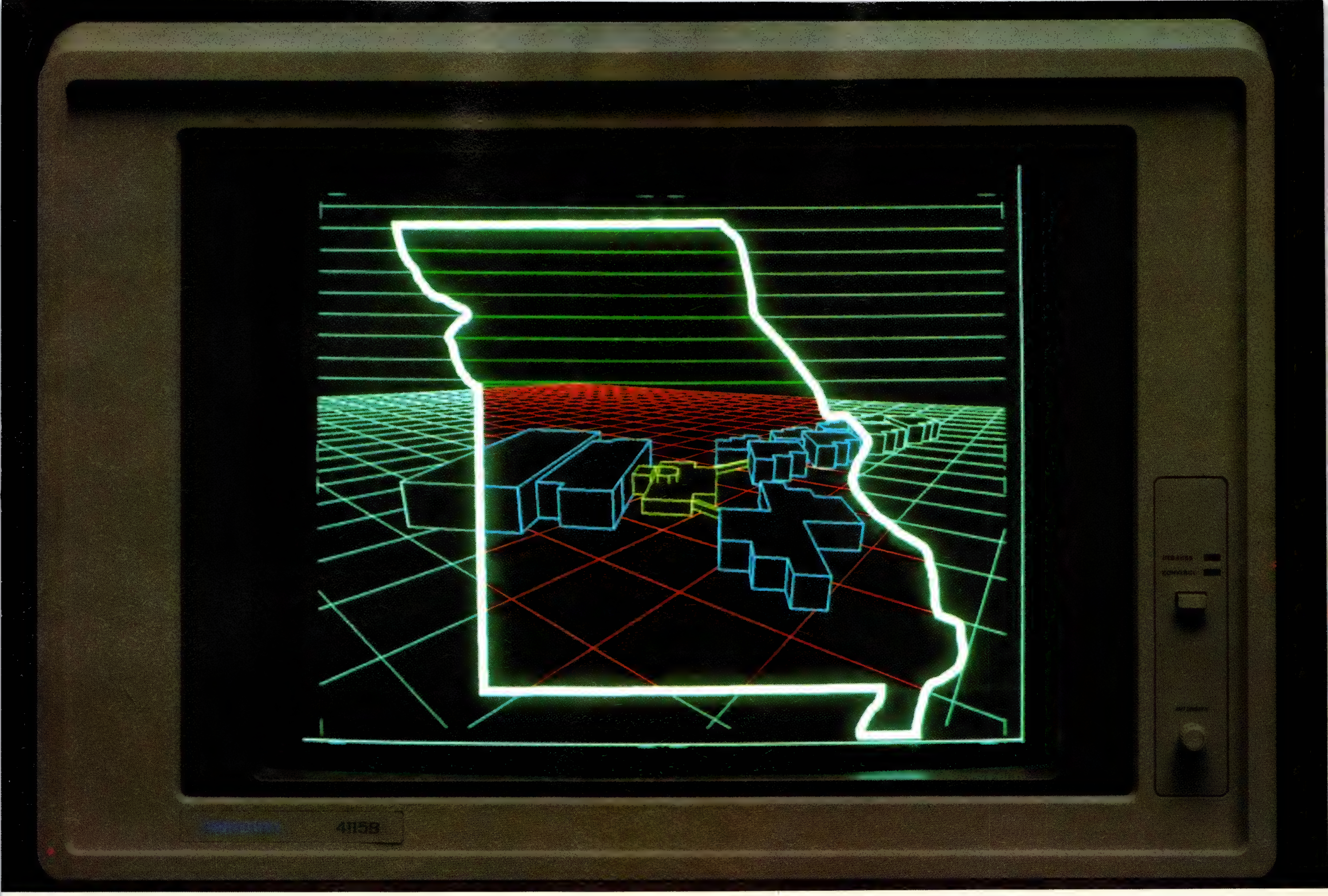
It's that kind of political commitment and quick response to industry that sets North Carolina's high-tech recruitment strategy apart from those of many other states. "You couldn't get a multimillion dollar research center set up that fast here," remarks Maury Hagerman, chief of Florida's Bureau of Economic Analysis.

**Favorable politics.** "Business doesn't get any political interference from us," notes Alvah Ward, director of North Carolina's Division of Industrial Development, in explaining the state's corporate recruitment success. "We do what the company wants, not what the local mayor or chamber of commerce recommends."

North Carolina's success at attracting corporate investment led to its current fifth-place ranking among U.S. cities in the minds of 421 U.S. electronics companies planning future expansions for new manufacturing or commercial facilities, according to a survey by the Electronics Location File of London. Only California, New York, Texas, and Illinois are more popular.

Nor is the new business coming to the state just from other areas of the country. Last year, international investment exceeded $345 million, up 170% from 1982. Of the 59 foreign firms planning to open shop in the U.S., 19 of them went to North Carolina, according to *Industrial Development* magazine.

Many companies cite North Caro-



The St. Louis campus of McDonnell Douglas Automation Company as modeled by McAuto's Building Design System.

# McAuto is building dreams in Missouri.

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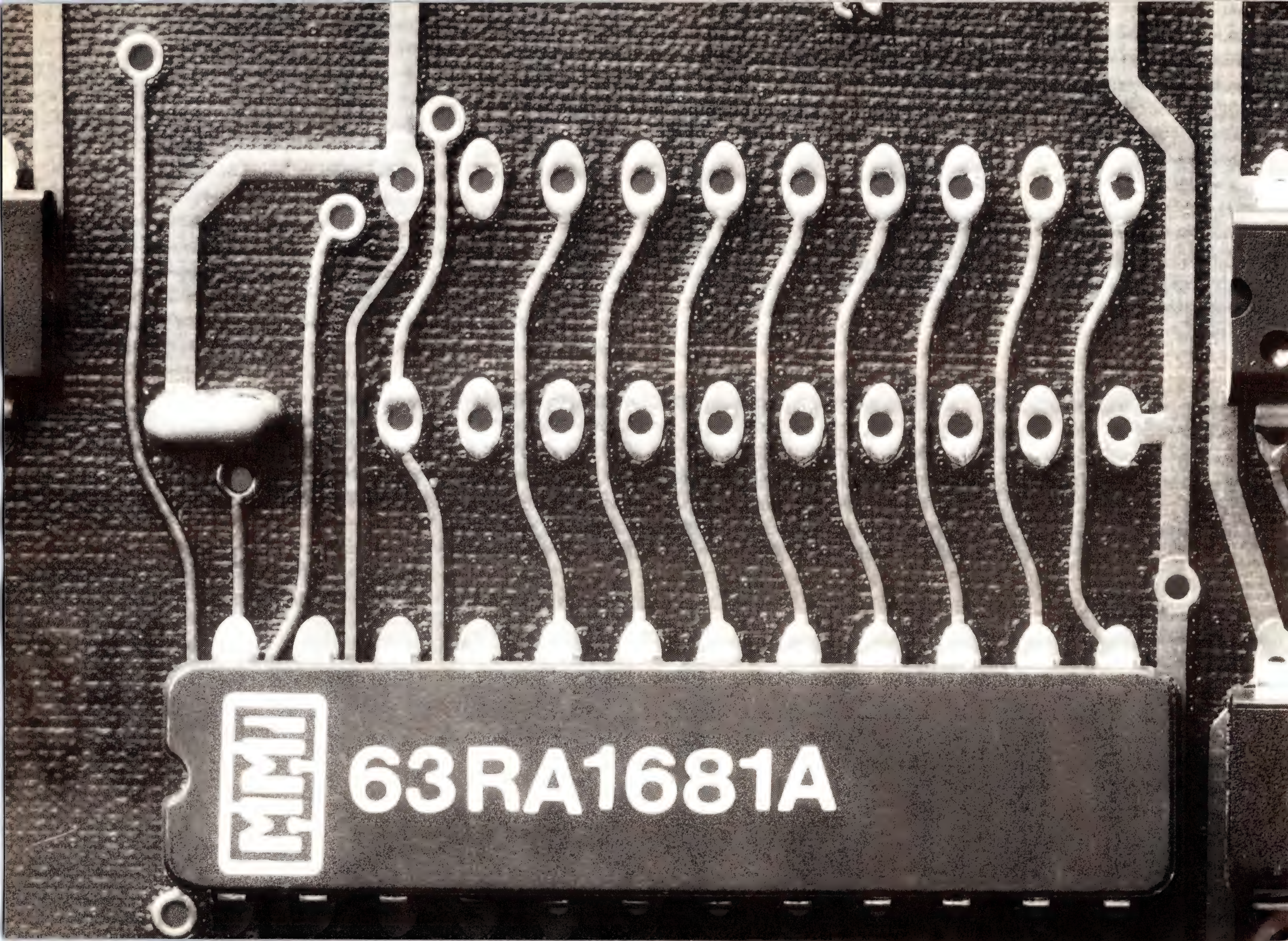
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lina's tailor-made training programs as the main reason for deciding to build a plant in this vicinity. One such is Sumitomo Electric Industries Ltd., Osaka, Japan, which plans to build a $50 million fiber-optics facility here.

Tampa, Fla., Austin, Texas, and Greenville, S.C., were in the running, reports Nobuo Makino, Sumitomo's treasurer. All offered to underwrite training for the 150 plant operators Sumitomo will need, but only Durham Technical Institute said it would send a professor to Japan to study the culture and language before setting up the course. "That really impressed us," Makino says.

**More praise.** The state's pool of scientists and engineers also gets high marks. According to the National Science Foundation, North Carolina has the country's second highest concentration of Ph.D.s per capita, with a total of 7,600. "Not only can you attract them but you can keep them as well," remarks Emory Lane, manager of business development and planning for GE's Semiconductor Business Division. Because the state has only three other semiconductor firms besides GE—Semicon Inc., Mitsubishi, and West Germany's Dynamit Nobel AG—engineers aren't tempted to bounce from one company to another.

Still, as more high-tech operations flock to this area, it's bound to get tougher to recruit from within the state. In 1982, graduate and undergraduate degrees in electrical and electronic engineering conferred by state institutions totaled 268, placing North Carolina in the 19th spot nationwide.

The state has already lost one important high-tech investment because of an educational weakness. When B.R. Inman was considering a site for Microelectronics and Computer Technology Corp. in 1983, he told North Carolina officials that all the ingredients were in place except for a top-notch computer science department at one of the three universities surrounding Research Triangle Park.

"We responded by giving the University of North Carolina at Chapel Hill $10 million for a new computer science classroom and laboratory building," recalls Ward. Inman decided on Austin for MCC, anyway [*Electronics*, May 31, 1983, p. 56], but "when we don't land them, at least we learn from them."

The state's "very, very pro-business climate" is also attractive to high-tech firms, Ward says. For example, the state's corporate income tax is 6%, compared with 9.6% in California and 8.3% in Massachusetts. Also enticing is its extremely low rate of unionization, about 5.9%, and a manufacturing wage which is about $1 lower than the national average.

Overall, the greatest high-tech payoff to the state has come from creating MCNC. In 1978, two years before Gov. Hunt disclosed plans for MCNC, electronics investment in the state totaled $41 million. Twenty-one tenants were located here with 9,629 employees and a payroll of about $60 million. In 1983, electronics investment had grown by more than seven fold to $316 million, just slightly less than new investment in the state's largest industry, textiles. Now Research Triangle Park has more than 45 occupants and a payroll of $600 million. The number of employees stands at 25,000 and is expected to double by 1995.

Though the state has succeeded in attracting established high-tech firms, its record is woefully short on high-tech spin-offs and start-ups. Last year, it won 18 federal grants to support small business innovation, placing 19th in the nation. By contrast, Virginia, which considers North Carolina its principal rival for new manufacturing investment, ranked fifth with 55 awards. Moreover, the Research Triangle Park phenomenon has spawned only a handful of indigenous electronic and biotechnology firms, and none of these has gained national recognition.

**Role model.** Robert Nichols, who formed Network Products Inc., a supplier of multiplexers, modems, and small data PBXs, here 2½ years ago, is not optimistic about the prospects for North Carolina start-ups. The main problem is the absence of a highly successful, local role model, he contends. "When you see a colleague who has gone out on his own and is now driving a Ferrari, it really gets your juices flowing." There is no state-grown firm on par with a Digital Equipment Corp. or a Hewlett-Packard Co. "You need that degree of success to start the snowball rolling," he says.

In addition, the state's universities are organized and funded to emphasize applied engineering rather

**Nonconformists.** North Carolina does not buy high-tech companies through low rents, tax breaks, and other incentives, says Alvah Ward, director of industrial development.

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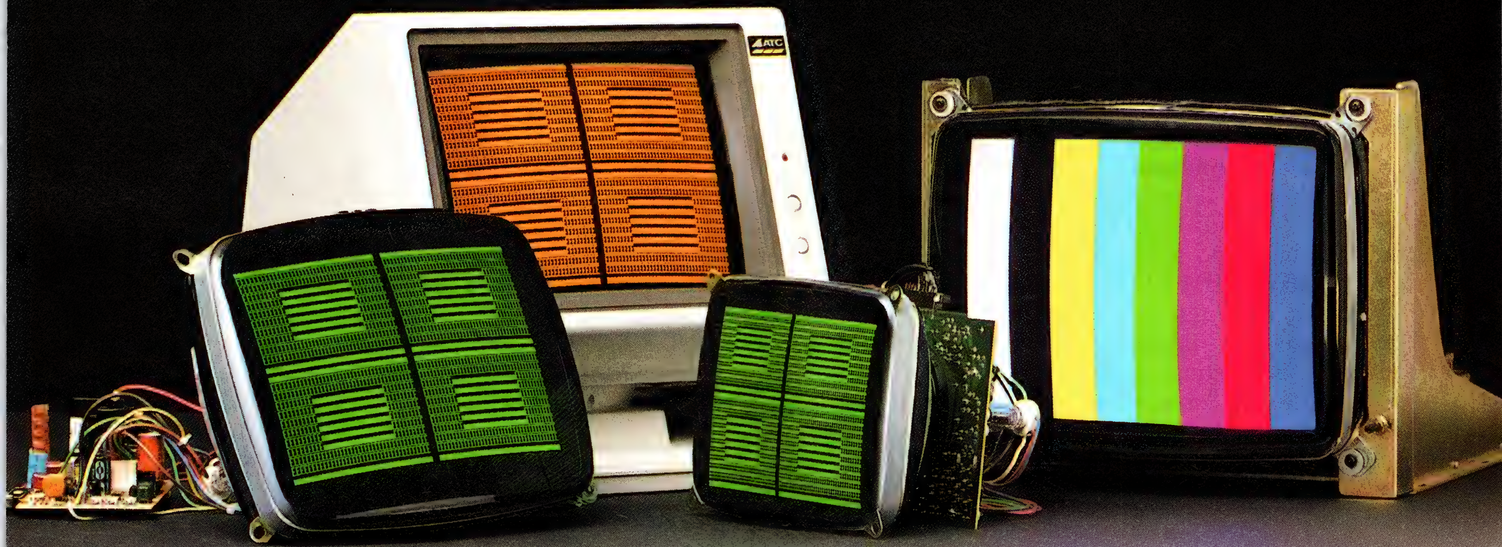

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**Wanted: father figure.** A successful, North Carolina-based role model is needed to inspire a wave of local start-ups, claims Robert Nichols, president of Network Products Inc.

than basic research, out of which major technological advances often spring.

A shortage of people with straight business backgrounds is another obstacle for potential entrepreneurs, observes J. David Hill, president of CTI Data Corp., a Raleigh start-up that makes IBM 3270-compatible terminals. With research as the dominant activity in the state, there is a dearth of marketing, sales, and financial specialists. Services that typically support new ventures—such as accounting, legal, and advertising operations—are also lacking. "You need all these ingredients to put a team together," he says, adding that most of his management staff was recruited from outside the state.

**Culture shock.** Furthermore, the state's pervasive conservativeness also works against entrepreneurship. "North Carolinians are not prone to risk-taking or putting their career on the line," he asserts. That is why the attrition rate in high-tech companies is around 5% versus 20% to 25% in Silicon Valley.

Preference for the status quo also extends to state banks, reports George Middlemas, vice president of Citicorp Venture Capital. Banks are still oriented toward the state's traditional industries—textiles, wood processing, and tobacco—and are not aware of the needs of high-tech companies. They could do more in terms of taking equity positions, financing the leasing of equipment, and providing more generous lines of credit. To get venture capital, young, high-growth companies are forced to go outside the state, he notes.

There is some evidence that the entrepreneurial climate is improving. Northeastern banks are starting to take an interest in North Carolina, which should put pressure on local banks to compete. The state's few start-ups have formed the Council for Entrepreneurial Development to stimulate the flow of seed money and also advise would-be entrepreneurs.

The state, too, has started to move by establishing the North Carolina Innovation Research Fund to provide grants up to $50,000 to new product developers. The new Technological Development Authority follows the trend among states to fund and promote incubator groups—partnerships of educators, marketing and financial consultants who lend their expertise to small businesses involved in emerging technologies.

Still, the home-grown trend probably won't accelerate soon, cautions Middlemas. The experience of Silicon Valley and Boston's Route 128 suggests that this area needs at least another 5 to 10 years to assemble the critical mass that will really get things perking. **–Karen Berney**

## FOREIGN TRADE

# Japan rekindles software dispute

**Tokyo**—Japan's controversial software protection bill, which seemed dead for this year when it failed to reach the Diet earlier this summer, is apparently alive again. U.S. trade negotiators, in Tokyo for recent talks with their counterparts in the Japanese government, again raised the issue after learning that the original sponsor of the software bill, the Ministry of International Trade and Industry, was including a clause on software in a forthcoming network information promotion law that could be presented to the next Diet session in December.

"We again expressed our opposition to the Japanese concept, which defines software under industrial law, not copyright law as in the U. S. and most other nations," says Clyde Prestowitz, counselor to the U. S. Secretary of Commerce. The issue is on the agenda for the Sept. 13-14 Washington meeting of the U.S.-Japan high-technology subcommittee, an intergovernmental group formed two years ago to deal with high-tech trade issues.

The key U.S. objection to the original MITI software proposal [*Electronics*, May 3, 1984, p. 32] concerned provisions for the compulsory revelation of a company's software program code at time of entry into the Japanese market, as well as allowing a third party to copy and sublicense (remarket) software without the originator's permission.

"There is nothing left to discuss on these points," says Prestowitz. "It's a fundamental difference in approach. We're unalterably opposed, and we have reminded the Japanese of that."

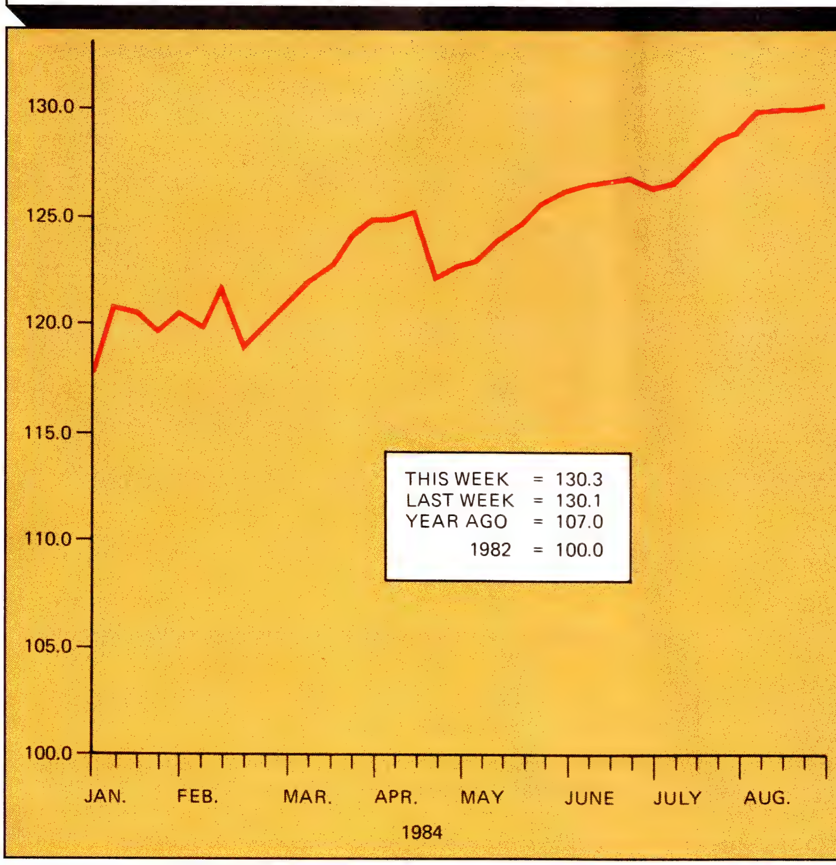
**More issues.** Two other electronics-related issues included in the recent Tokyo talks were the inclusion of U.S. representatives in Japanese standards-setting groups, and the approval of U.S. laboratories as product-certification sites for telecommunications products seeking entry into the Japanese market.

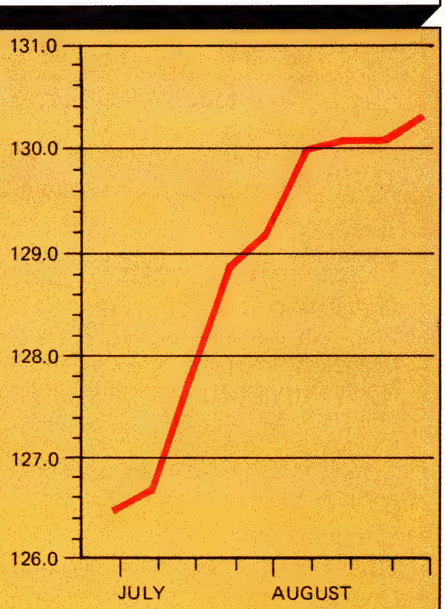
A new telecommunications law is being written for submission to the December Diet session, and it is likely to pass and take effect next April 1. U.S. officials say that their dialogue with the Japanese is continuing, but they could report no concrete progress on either issue.

Applied Research Laboratories Inc. of Miami, Fla., has been certified by MITI for factory production inspection [*Electronics,* June 28, 1984, p. 74]; more recently, Underwriters Laboratories Inc., Northbrook, Ill., was given approval to test electric appliances and certain other consumer goods to be sold in Japan.

Such approval does not include sophisticated electronics products. The U.S. wants the legislative ordinances altered to allow foreign-based testing and certification procedures of this equipment. **–Michael Berger**

# ElectronicsWeek Index





The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear below from week to week.

## U.S. INDUSTRIAL PRODUCTION INDEX

| | June 1984 | May 1984 | June 1983 |
|---|---|---|---|
| Office and data processing equipment | 322.2 | 316.1 | 266.0 |
| Communications equipment | 203.7 | 202.9 | 177.2 |
| Radio and TV equipment | 110.9 | 103.9 | 91.2 |
| Electronic and electrical instruments | 175.7 (July 84) | 174.3 (June 84) | 159.3 (July 83) |
| Components | 444.1 | 446.5 | 348.1 |

## U.S. GENERAL ECONOMIC INDICATORS

| | July 1984 | June 1984 | July 1983 |
|---|---|---|---|
| Index of leading economic indicators | 165.3 | 166.6 | 158.2 |
| Budgeted outlays of the federal government ($ billions) | 68.432 | 71.283 | 65.360 |
| Budgeted outlays of the Department of Defense ($ billions) | 18.870 | 19.659 | 17.394 |
| Operating rate of all industries (% capacity) | 81.0 | 80.4 | 75.2 |
| Industrial-production index | 165.6 | 164.1 | 149.7 |
| Total housing starts (annual rate in thousands) | 1,761 | 1,886 | 1,793 |

***An increase in*** production of electronics products, though partly offset by declines in auto production and defense spending, gave a slight boost to the *ElectronicsWeek* Index in the latest week. The production gain was not evenly distributed, however. Output of components, a leading electronics indicator, fell 0.5% in June. At the same time, the overall index of leading economic indicators fell for the second straight month.

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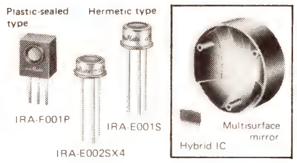

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| IRA-F001P | 55V/W | 1-20µm | 80° | Polyethylene |
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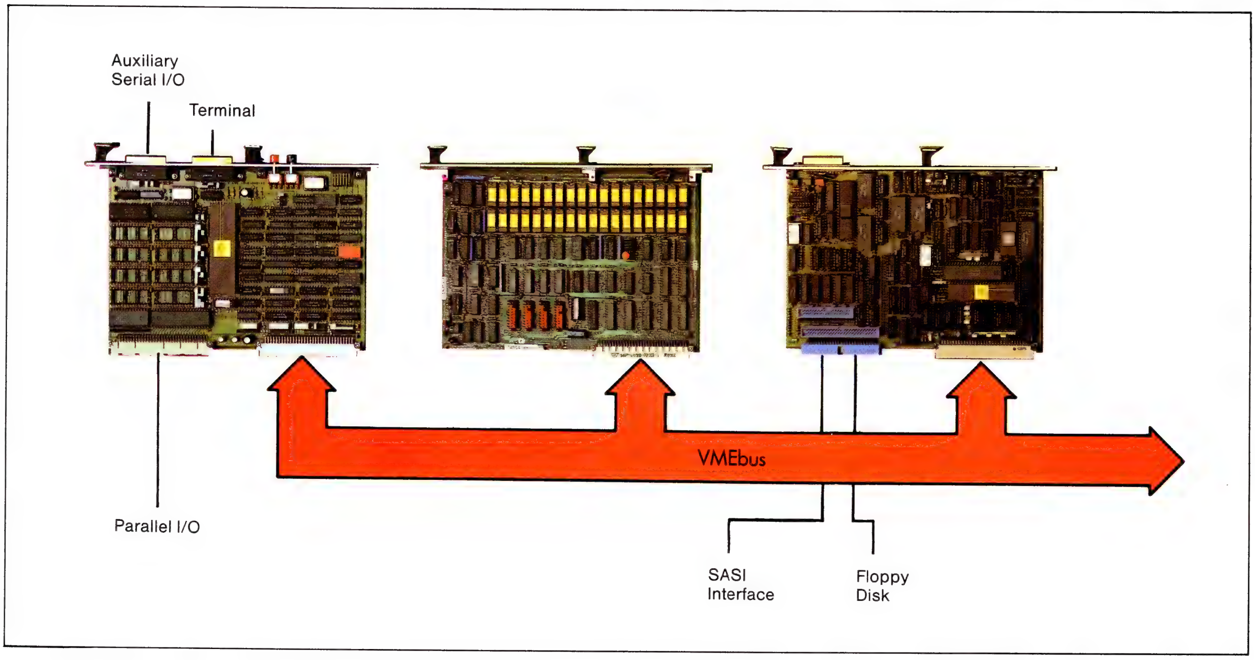

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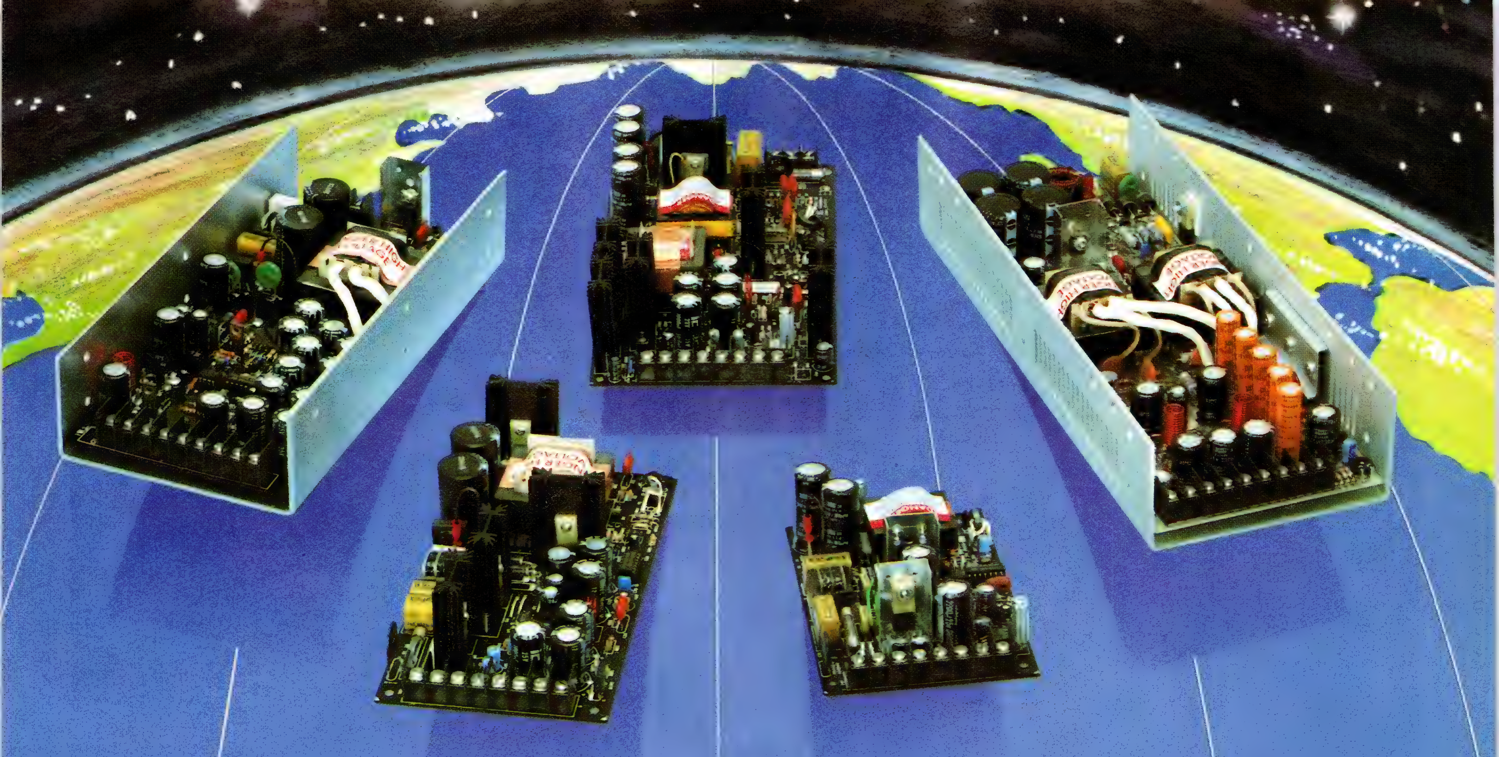

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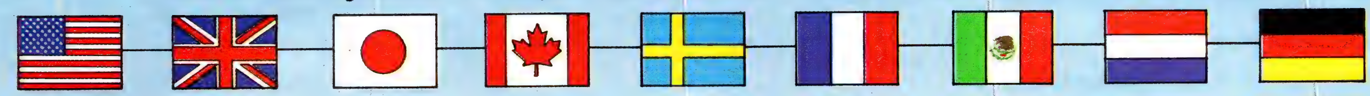

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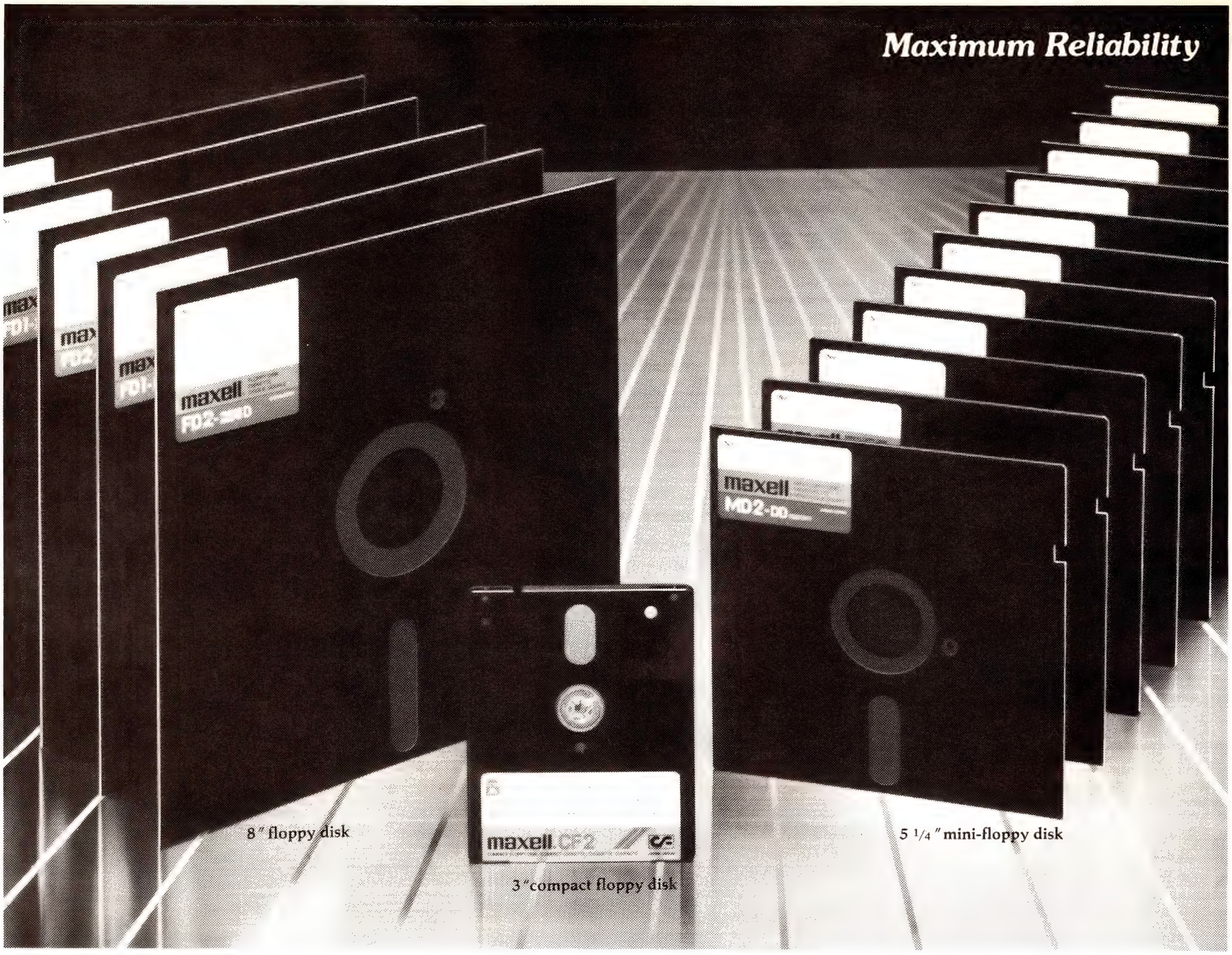

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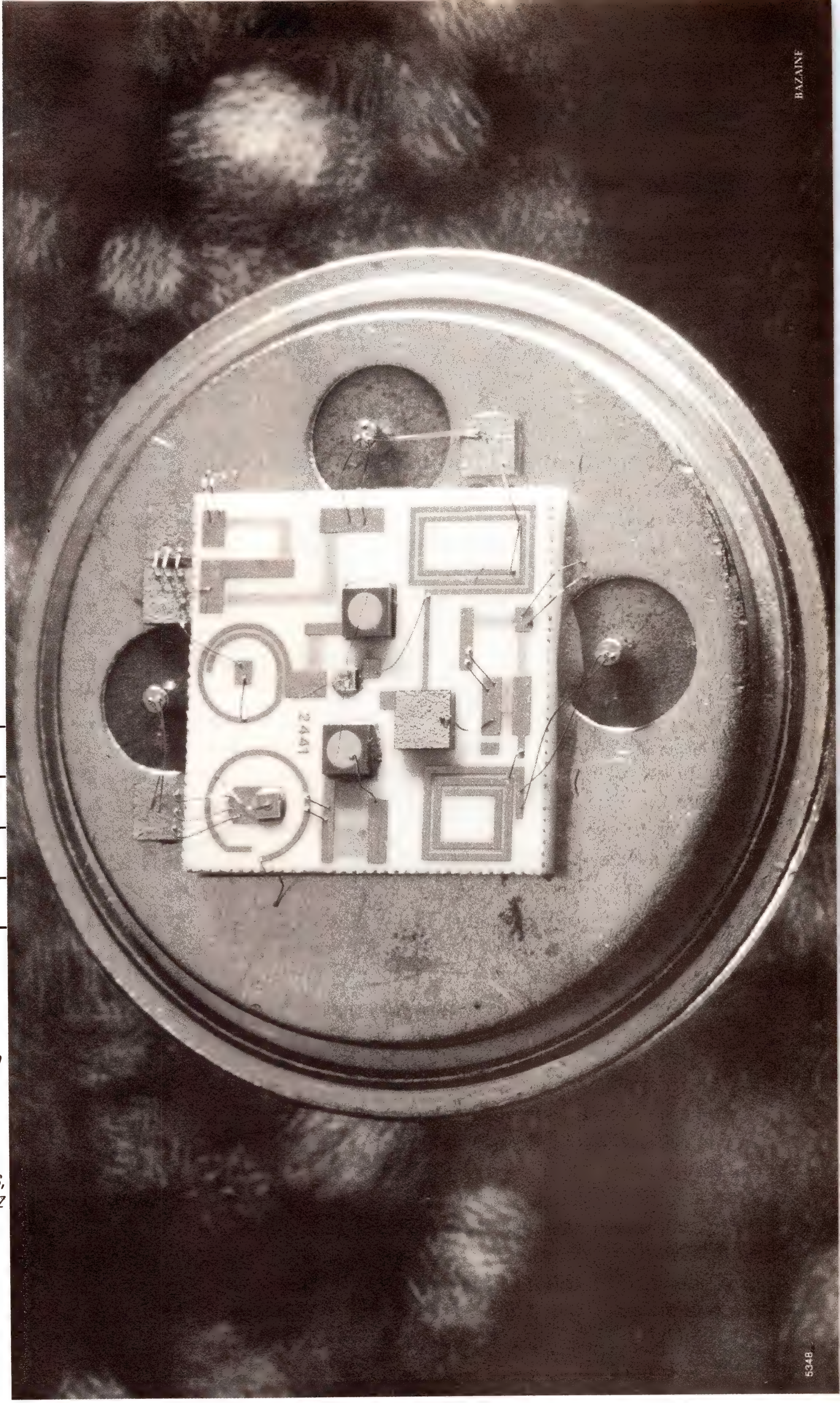

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# NSF'S 1984 ANALYSIS AS A CAMPAIGN DOCUMENT

Before Ivan Petrovich Pavlov died in 1936, he listed three qualities that Soviet youth should cultivate if they expected to become recognized leaders in their field: first, there is what he called "gradualness," followed closely by modesty and passion. Those priorities and the result they are intended to produce are worth recollection by readers of the National Science Foundation's new publication titled "National Patterns of Science and Technology Resources—1984."

There is more passion than modesty or gradualness displayed in much of the NSF analysis of U.S. research and development patterns. The NSF's uncharacteristic passion for putting a distinctly positive cast on some of the numbers gives the report a definite political bias in this election year. For example, according to the publication, each year a significantly larger share of defense R&D monies is going to development programs as big-dollar strategic systems move closer to production. The obvious result of this is that some new and promising research is getting short shrift.

NSF seeks to soften this judgment by finding signs that electronics and other leading industries are helping to counter this research gap, encouraged by the 25% tax credit for incremental R&D spending contained in the Economic Recovery Tax Act. Yet those producers fighting to extend ERTA beyond its 1985 expiration derive slight solace from the NSF conclusion because it is based on 1981 data—the first year the act was in force.

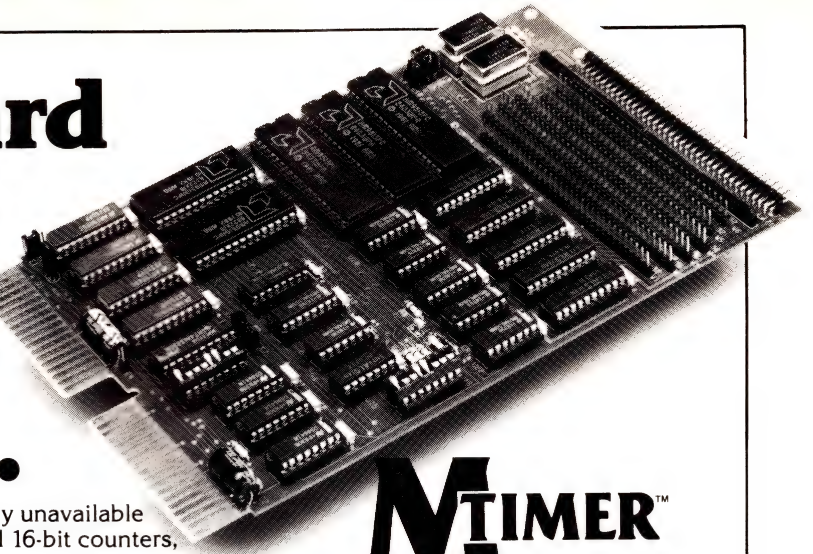
While NSF estimates that the $97 billion the country will spend for R&D this year will be some 11% more than last year, the applications technologies that are being both promoted and ignored, as well as the kinds of jobs they are creating, provide some intriguing insights.

Although Uncle Sam continues to bankroll roughly half of the nation's R&D—some $45.6 billion in 1984—the proportion identifiable as military outlays is expected to reach a new high of 70% of the federal total this year, while R&D for environmental improvement, natural resources, education, and training will receive less funding this year.

The NSF assessment of science and engineering education and job trends provides some surprises, particularly in the categories of computer scientist and electrical engineer. For example, the conclusion that engineering and science job markets have increased more rapidly than others is attributed in the report to "recent efforts to increase productivity and improve the international competitiveness of U.S. industries." Scoffs one Labor Department analyst, "Productivity and competitiveness sound nice, but they don't generate jobs: they eliminate them."

As for U.S. industry's need for new engineering and science graduates, NSF says that the shortages of graduates reported in mid-1981 had "moderated substantially" by mid-1983—except in the crucial categories of computer scientist and electrical engineer. Nevertheless, the report suggests that supply and demand are coming closer to balance in these areas, too, even though the evidence is slight and outdated.

Thus has NSF surprisingly produced an immodest document which suggests that gradualness, untainted by the passion of politics, has prevailed in its engineering and science resource assessment. The spirit of Ivan Petrovich Pavlov would surely be dismayed by the demonstration of an ostensibly independent national science organization that can be made to salivate on cue. –**Ray Connolly**



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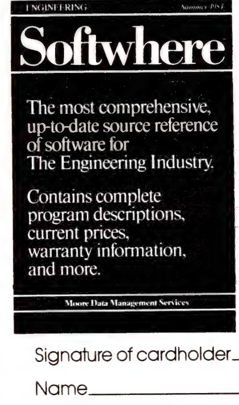

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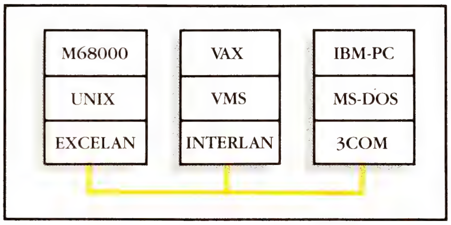

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# INCREASED U.S. - JAPANESE TRADE IS THE GOAL OF JETRO's SATO

**More trade.** Mitsuaki Sato now heads Japan's effort in the U.S. to attract foreign trade and technology exchanges.

**New York**

Mitsuaki Sato came to New York for the first time in 1965 as a William Fulbright scholar at Columbia University, where he earned a master's degree in economics. Sato, 51, says he remembers the famous 1965 blackout and other travails distinctively New York. Those memories undoubtedly eased the transition when he returned to the city this July to become chief executive director of the Japan Trade Center.

The center is operated by the Japan External Trade Organization with the purpose of promoting trade in finance and commercial goods between Japan and other countries. Among JETRO's services are market research surveys, including an annual survey of Japanese manufacturers in the U.S. This year's survey reveals, for example, that throughout 1983 Japanese companies operating in the U.S. continued efforts to combine Japanese and American management techniques to improve productivity.

Sato, who heads a staff of 30 Japanese and 25 Americans, cites projections for a $20 million to $30 million trade imbalance between Japan and the U.S. in 1984. "Too much imbalance is not good for the exporting country or the importing country," he says. The Japanese government's position, however, is that "the balance should be accomplished on a multilateral basis, not bilaterally."

Before joining JETRO, Sato spent 26 years with Japan's Ministry of International Trade and Industry, first in its Planning and Coordination Department where he eventually became director and most recently as deputy director general of the Economic Planning Agency's Price Policy Bureau. While there, he helped bring about JETRO's shift from export promotion to its current emphasis on import expansion and industrial cooperation, including overseas investment and technology exchange. "The function of our organization has changed 180°," he emphasizes.

With a huge balance-of-trade surplus, Sato explains, Japan now seeks exports through projects such as the Made In USA Fair, scheduled for March 1985 in Nagoya. The exhibition, jointly sponsored by JETRO and the U.S. Department of Commerce, will feature U.S. manufacturers, exporters, industrial associations, branches, and agents located in Japan. JETRO expects to have 300 booths at the import fair. Such projects make Japan the only nation actively seeking exports, Sato adds.

Telecommunications, computer-aided design and manufacturing, analytical instruments, and medical equipment are among the areas covered in the technology exchanges, Sato says. When asked about Japan's reluctance to exchange technology in the past, he replies that he foresees "a new era, a new frontier for Japanese companies" in high-technology exchange. Moreover, he adds, Japanese firms are seeking to curtail rising high-technology research and development costs through joint ventures. **–George Leopold**

## Thorndyke is taking ETA Systems down VLSI path to a new supercomputer

**Recycle.** Lloyd Thorndyke is putting years of work on VLSI design simulation to advantage in his supercomputer development.

**St. Paul, Minn.**

Just when Japanese manufacturers are emerging as formidable competitors in the supercomputer business with designs based on traditional emitter-coupled-logic technology, the field's established U.S. vendors are veering away from ECL for their next-generation machines. Indeed, supercomputer design appears to have reached a fork in the road, observes Lloyd M. Thorndyke, president and chief executive officer at ETA Systems Inc.

Where previous generations of U.S.-built machines all relied on ECL, supercomputer wizard Seymour R. Cray at Cray Research Inc., Minneapolis, is working on a next-generation multiprocessor machine to be built using gallium arsenide technology. ETA Systems is taking another route. The Control Data Corp. spin-off will rely on liquid-nitrogen-cooled, very large-scale integrated complementary-MOS gate arrays in developing the successor to the Cyber 205. ETA will use this technology as the basis for its eight-processor GF-10 machine planned for delivery in late 1986.

As the former Control Data senior vice president of technology development and director of the 205 design effort, the 57-year-old Thorndyke sees the divergence as a healthy development. Increased competition from Japan's Fujitsu, Hitachi, and NEC—as well as from Denelcor Inc., in Aurora, Colo.—is helping to spawn new design approaches in the supercomputer field, he says. "More creativity is required now than in the past, maybe because we've got more competitors."

The Minnesota native—who grew up in Pipestone, just a few miles from the home town of Gene Amdahl, another computer industry luminary—is quick to point out that "the road one goes down is to some extent based on your heritage." By that, Thorndyke means that because CDC has focused a great deal of work on VLSI design simulation in recent years, it is logical for ETA to take advantage of that expertise in its development work. But he notes, too, that increased competition in the supercomputer business tends to make customers more aggressive in stating their needs, thus pushing manufacturers to step out with bolder design strategies.

As for foreign competitors, Thorndyke notes that "the Japanese are very methodical and tend to plan and predict long range. And, certainly, if you looked at Control Data in the 1960s and 1970s and Cray in the 1970s, one could draw the conclusion that it's ECL forever."

Both Fujitsu and Hitachi have announced machines that implement denser ECL circuits (about 1,300 gates) with switching speeds about twice those of any demonstrated by U.S. vendors, Thorndyke says. "So from that standpoint, they planned ahead. However, somewhere between the time they laid their plans out and then executed them, the two U.S. vendors have decided to look at different circuit technologies."

Thorndyke, who earned a BS in physics in 1950 from Hamline University, in St. Paul, is careful not to criticize his competitors' design approaches. But he is naturally optimistic about his own firm's path. After 30 years of work at Minneapolis computer firms, including 23 years at CDC, he has plenty of experience to draw upon. **–Wesley R. Iversen**

## USAF's Chubb finds private-sector gremlins pester Electronic Systems Division, too

**Hascom AFB, Mass.**

It's unlikely that when Lt. Gen. Melvin F. Chubb Jr. launched his military career he anticipated commanding an industrial organization with a budget of nearly $4 billion and some 10,000 employees. But that's the position Chubb assumed when he took command in August of the Air Force's Electronic Systems Division here.

**Waste warrior.** Lt. Gen. Melvin F. Chubb Jr. finds that he must wage the same business battles as any other executive.

ESD is a broad-scope operation typically encompassing more than 100 projects at any given moment. The Airborne Warnings and Control System (AWACS) was developed here, and the division is now overseeing programs to improve the Worldwide Military Command and Control System and develop the Joint Surveillance Target Attack Radar System (Joint Stars).

The 50-year-old Chubb's last post was in the Aeronautical Systems Division at Wright-Patterson Air Force Base, Dayton, Ohio, where he managed the acquisition of systems for B-52 weapon improvements, B-1 research and development, the short-range attack missile program and the B-1B program.

Chubb is a rated pilot and combat veteran of 500 missions and 1,000 hours of combat time, experience which he says "has some bearing [on the work in ESD] but is secondary." More important, he says, are managerial and business skills, along with aggressiveness. "I look for people who are very aggressive," he says.

The officer corps Chubb commands at Hanscom has lost large numbers of captains and majors—read: middle management—to private industry. He estimates that lieutenants have risen from 10% to 40% of the corps in the last decade.

"They are better trained, but you still have to have that experience," says Chubb. What can be done at his level to keep these officers in the military is to "make sure they are challenged with tough jobs. They'll never make as much pay [as they might in private industry], but they'll always have more responsibility."

For himself, Chubb says he never considered any career other than the military. He was born in Joplin, Mo., and graduated from the Wentworth Military Academy in Lexington, Mo. In 1955, he was commissioned into the Air Force after completing aviation cadet training.

He received a bachelor's degree in aeronautical engineering from Texas A&M University in 1962, and a master's degree in astro-engineering from the University of Southern California in 1965. In 1972, he received an additional master's in administration from George Washington University and also completed the Industrial College of the Armed Forces.

People talk about $10,000 hammers bought by the military, says Chubb, but he maintains that waste is relatively minor compared to the cost of on-again, off-again programs. "Keeping a program stable is the real money saver." **–Craig Rose**

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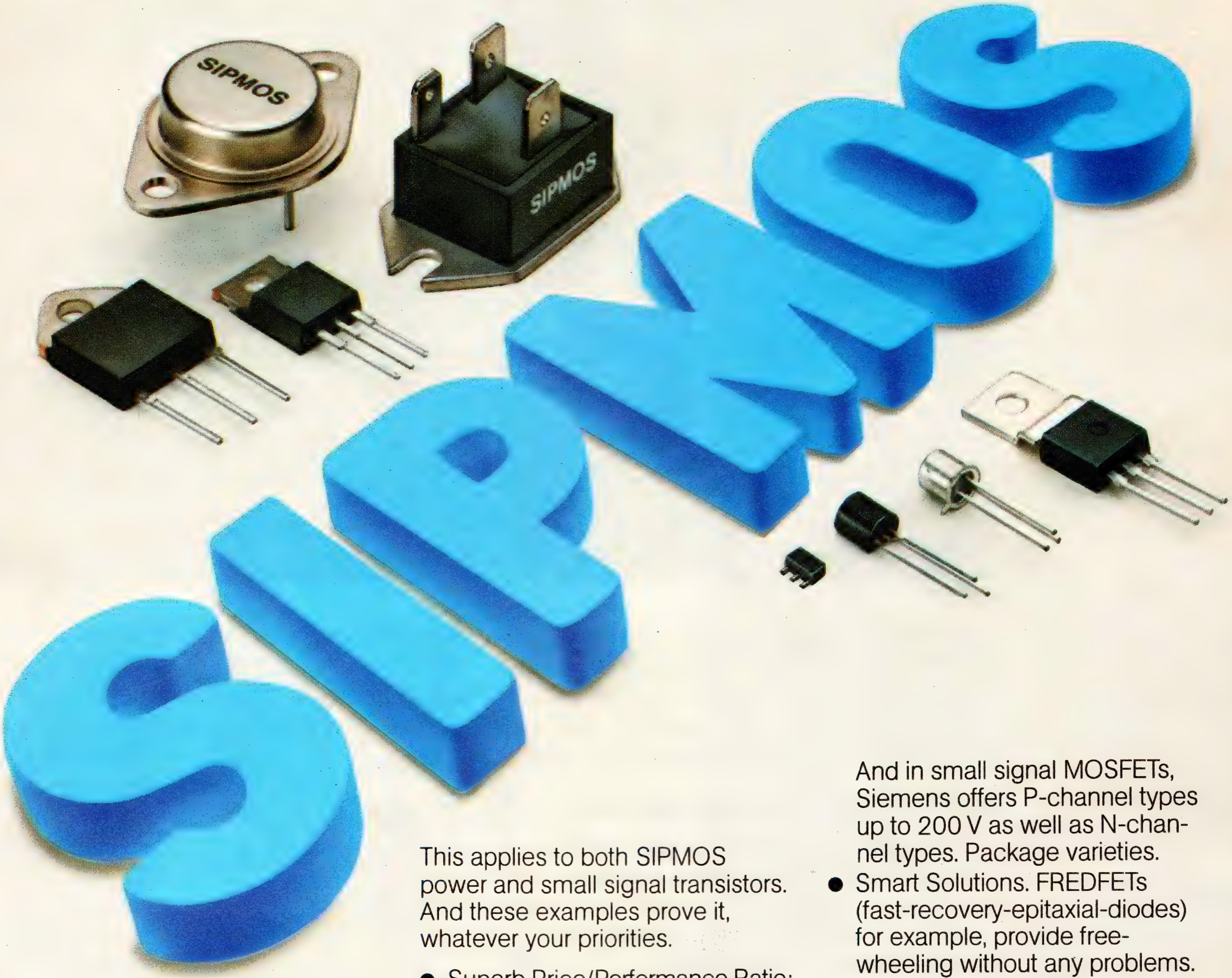

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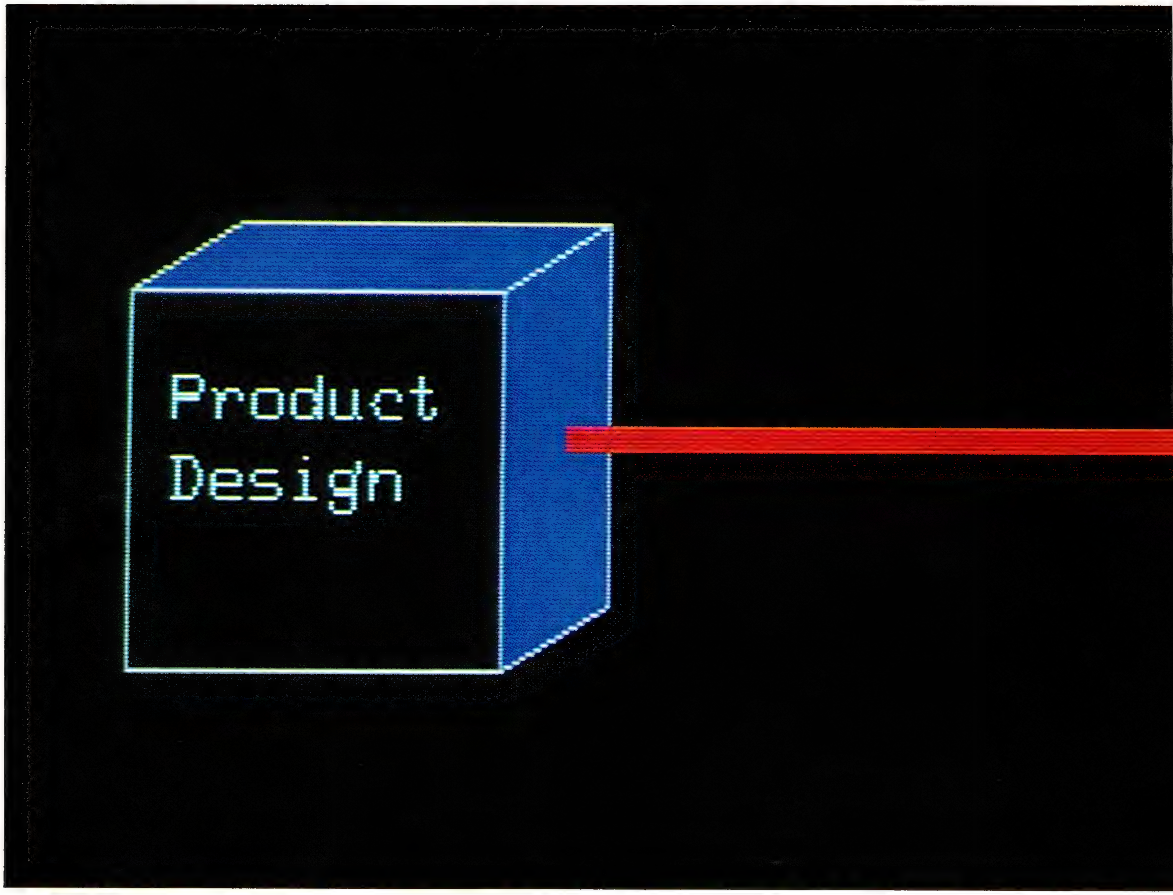

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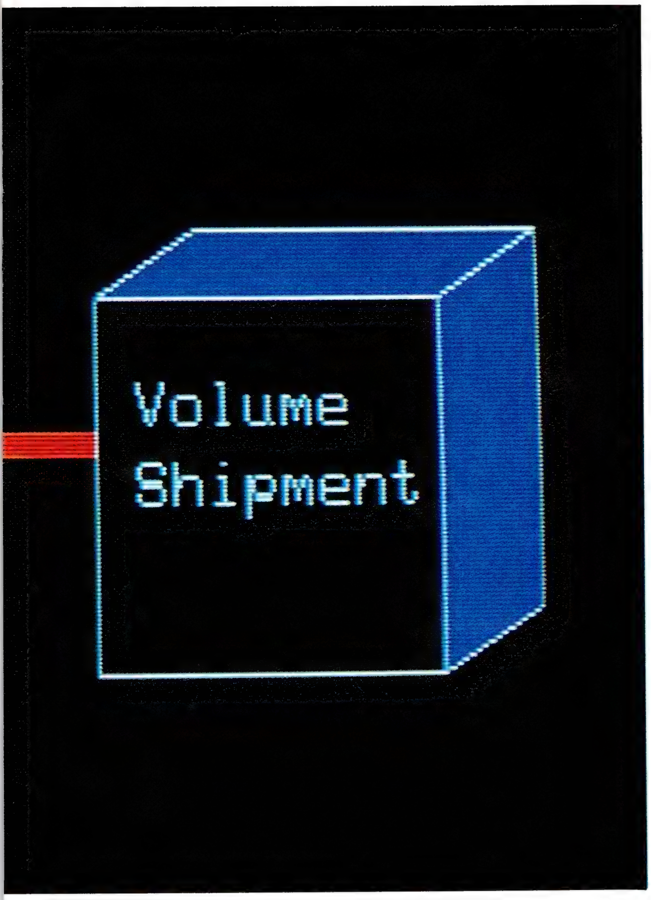

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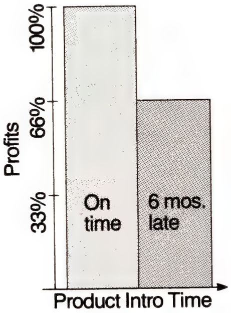

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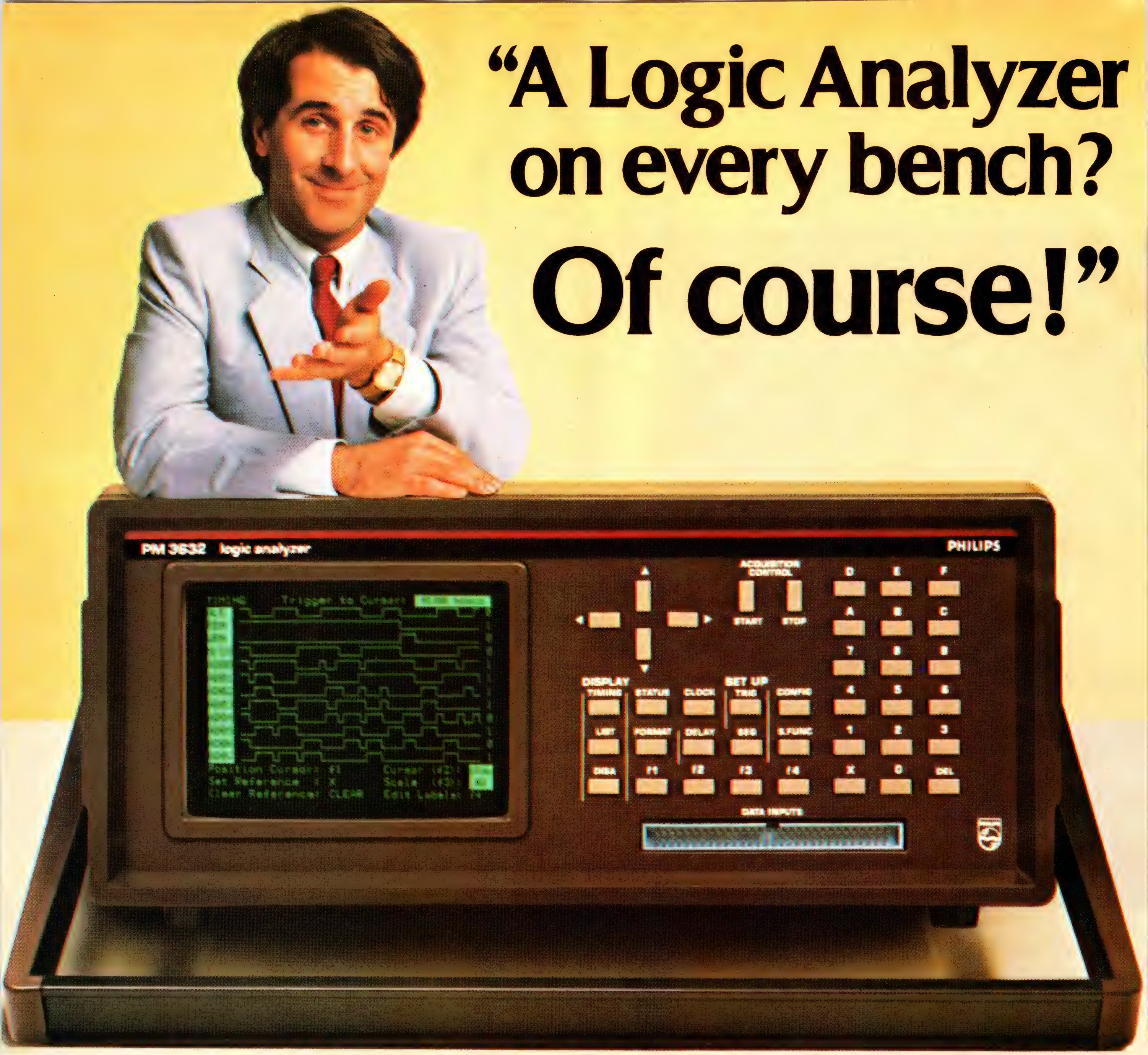

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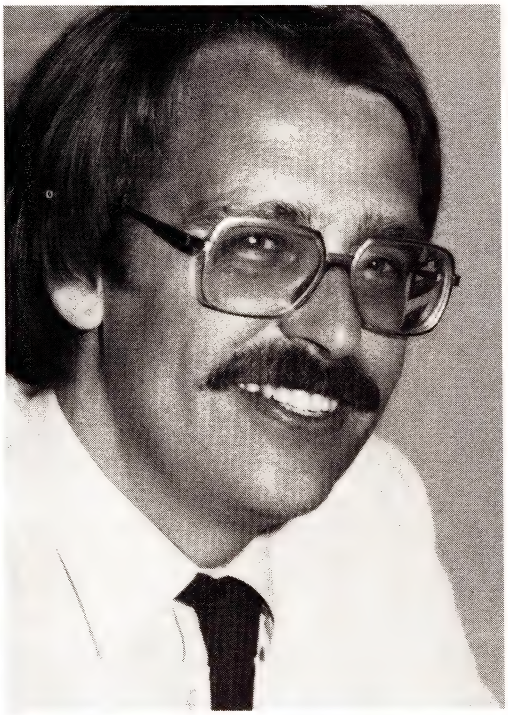
# COMPANY SPUN-OFF FROM SIEMENS THRIVES WITH PARENT'S BLESSING

**Munich, West Germany**

Integrated Circuit Testing GmbH stands out from the crowd. For starters, the product that this West German firm sells—a computer-controlled electron-beam system for testing very large-scale integrated circuits—is considered one of the most advanced of its kind. Furthermore, after only five months on the scene, the eight-person company has already bagged orders from such chip-making giants as Signetics Corp. and IBM Corp.



**Lending hand.** Without the help of Siemens, his former employer, "we would have had a hard time getting off the ground," says ICT technical managing director Hans-Peter Feuerbaum.

Yet another interesting aspect of ICT is how it got started. In April of this year, researchers Hans-Peter Feuerbaum and Peter Fazekas and salesman Burkhart Berghoff left Siemens AG to set up their new company in the Munich suburb of Ottobrunn. Their goal: to exploit the knowledge in electron-beam measuring technology that they had acquired at their former employer.

By Silicon Valley standards, that may not be an exciting tale. What may be, however, is that they weren't sued by their former employer, which happens frequently in the U.S. high-tech business. The trio of experts left with the genuine encouragement and blessing of Siemens executives. ICT thus constitutes what has become known in German industry circles as a "benevolent" spin-off [*Electronics,* June 28, 1984, p. 80].

**Helpful hand.** Not only did Siemens lend moral support to the new venture, says Feuerbaum, ICT's technical managing director, but it "allowed us to take along patents and use the results of the research we did at their labs," where he headed a research team. Furthermore, Siemens placed an order for electron-beam testers worth more than $1 million.

"Without the help of Siemens, we would have had a hard time getting off the ground," recalls Feuerbaum. "The benevolence of that company was essential to us." In return for its support, Siemens has the option to acquire 25% of the new firm at some future date.

On top of technical support, Siemens is giving ICT a financial underpinning. This comes via the German-American-British capital investment firm Techno Venture Management, in which Siemens has a nearly one-third share. TVM holds 49% of ICT's stock. The three founders and another engineer at the Ottobrunn firm hold the other 51%.

"We want to help researchers and engineers with bright ideas get on the market with products using these ideas," says Sigurd K. Christian Lingott, manager of the Siemens-owned firm, Venture Capital Beteiligungs GmbH, which is the vehicle for particpating in TVM. That explains Siemens' heavy investment in ICT, he says.

**Wasted efforts.** He points out that in a big company with strong research and development activities, not all projects result in marketable products, "either because they can not be meshed into our equipment range or the potential sales volume is too small for a large firm."

Besides letting its engineers commercially exploit the results of their research, which would otherwise languish in the archives, Siemens, like other German companies, is appreciating the role new ventures can play in advancing a country's electronics technology. There is also the job-creating potential that young high-technology firms offer.

"We are convinced that the idea of the ICT spin-off was sound—and necessary," Lingott says. "We are confident that the firm will succeed. If we weren't, we would not have recommended it to Techno Venture as a good firm in which to invest."

Virtually alone in the field at present, ICT offers an electron-beam tester that, when adapted to a scanning electron microscope from Amray Inc. in Bedford, Mass., analyzes the function of VLSI circuits under dynamic conditions [*Electronics,* July 14, 1981, p. 105].

By using a focused electron beam that scans the surface of the chip, the ICT 8410 tester performs noncontacting, nonloading measurements and maps the IC's logic functions. The beam implements the voltage-contrast technique, which causes logic levels to show up on a display as dark and light areas.

The tester works with relatively low acceleration voltages—down to 100 V—which are a prerequisite for nondestructive testing of ICs. In specific modes, the 8410 can be operated either as an oscillograph or a logic analyzer.

Assessing the market for such testers, Feuerbaum pegs the current world demand at between 1,500 and 2,000 units. "We hope to corner at least half of that market," he says. The demand is spurred by the increasing complexity of ICs to which access by external connections becomes more and more difficult.

ICT's 1984 target is for between 12 and 15 delivered units. The number, the executive says, should increase about threefold next year. The goal for 1986 is for more than 100 machines. Selling for roughly $180,000, the tester is intended for use in IC development, production, quality control, and incoming inspection.

Competitive testers from firms in the U. S. and the UK, Feuerbaum notes, either have not yet reached the market or have had quality setbacks. He concedes, however, that ICT won't be without stiff competition for long. **–John Gosch**

## Innovus takes aim at small market

**Mountain View, Calif.**

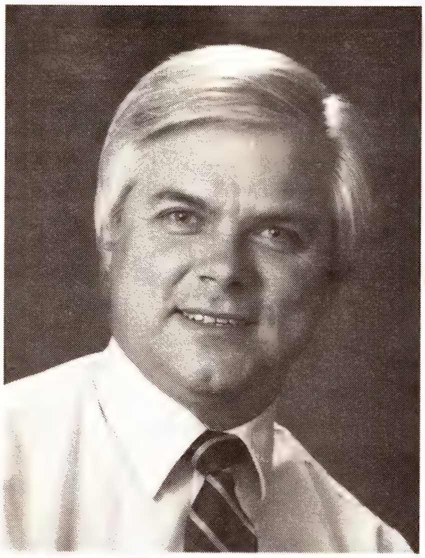
Sometimes a niche doesn't have to be big to provide a start-up with a suitable market. Consider the case of Innovus.

Armed with its newly developed technology, the one-year-old company is aiming at a small segment of the semiconductor capital equipment market. The firm is developing a new type of mass flow controller, which uses a new Innovus-developed sensor on a silicon chip. It will incorporate the new controller into a gas control and blending system for semiconductor process equipment.

**Largest market.** The market for this equipment will total about $85 million this year and grow to about $250 million in four years. "We're concentrating on the area we know best—the semiconductor industry," notes Innovus president Wayne Renken, a former director of strategic marketing and product planning at Applied Materials Inc. "That's the largest market segment and the one in which we can capture the largest share."

There are some additional potential markets for the firm's control system—including medical and analytical instruments—that could total another $60 million to $70 million. Although these markets would require a different marketing approach, "once we get a base in the semiconductor industry, we'll look at the other areas," Renken says.

The potential market may be relatively small compared with, say, the booming semiconductor market, but it is a critical one. Controlling the flow of gases used in making integrated circuits on wafers is "one of the biggest problems people have had, and no one's addressed it," claims Daniel Hutcheson, vice president of VLSI Research Inc., a San Jose, Calif., market research firm specializing in semiconductor production equipment. "Most of the controllers [now being used] don't handle it to the degree you'd like," Hutcheson says, adding that problems in wafer uniformity "can be traced directly to the controller."



**Smiling.** A small niche in a marketplace—in this case, for mass flow controllers for the semiconductor industry—looks good to start-up Innovus and its president, Wayne Renken.

Hutcheson also points out that new semiconductor production techniques require a faster switching of flows among various types of gases, depending on the production technique. Present-day controllers "are relatively slow," he says.

Renken believes his firm's product will satisfy the industry's needs. He claims the new sensor-on-a-chip, which is the heart of the controller system, is up to three times faster than current sensor technology. In addition, the new sensor offers greater calibration stability, because its multiple channels monitor and catch shifts in the gas flow, and the close placement of sensors on the silicon chip reduces temperature variations.

The cherubic executive says that developing the sensor-on-silicon technology was "90% of the risk but 20% to 30% of the work" facing his new firm. Now Innovus is working on the gas control and blending system for sale to producers of turnkey semiconductor production equipment for integration into their systems. That product will be out by the end of this year, Renken promises.

Renken's idea came while he was working at Applied Materials. After some initial work, the Santa Clara, Calif., firm decided to shelve the project and sold the assets to Renken and a group of investors for a 12% piece of Innovus, Renken says.

"The Applied Materials commitment worked out well in the beginning," Renken says. "We've had good support from Applied since then as well. We expect to give them a product they will definitely want to use."

**Employee-funded.** The initial work was funded by Innovus's employees, Renken says. A $1 million venture capital funding was completed this past June, and that should see the 11-person firm through to early next year, when it plans to seek more financing.

Renken is aware that being closely tied to one large potential customer—in this case Applied Materials—can sometimes work against start-ups as they seek to sell products to other companies that compete with the backer. Competing firms can worry that too close a relationship puts the start-up in the backer's pocket.

"That's not been a problem with the customers we've talked to," he says. Their [competitors'] concern is making sure proprietary information stops with us. For the most part, our customers are interested in what works for them." **–Robert J. Kozma**

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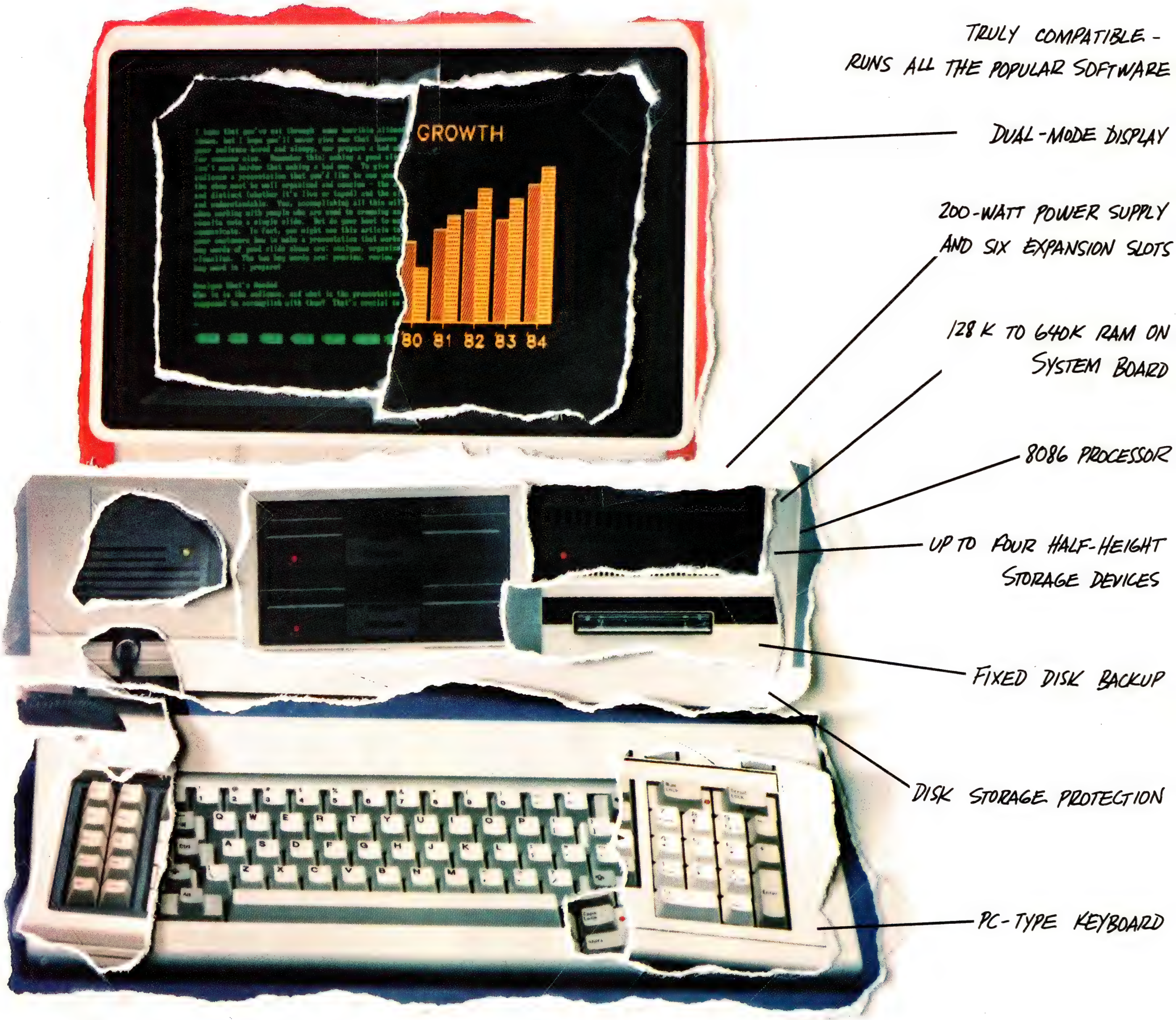
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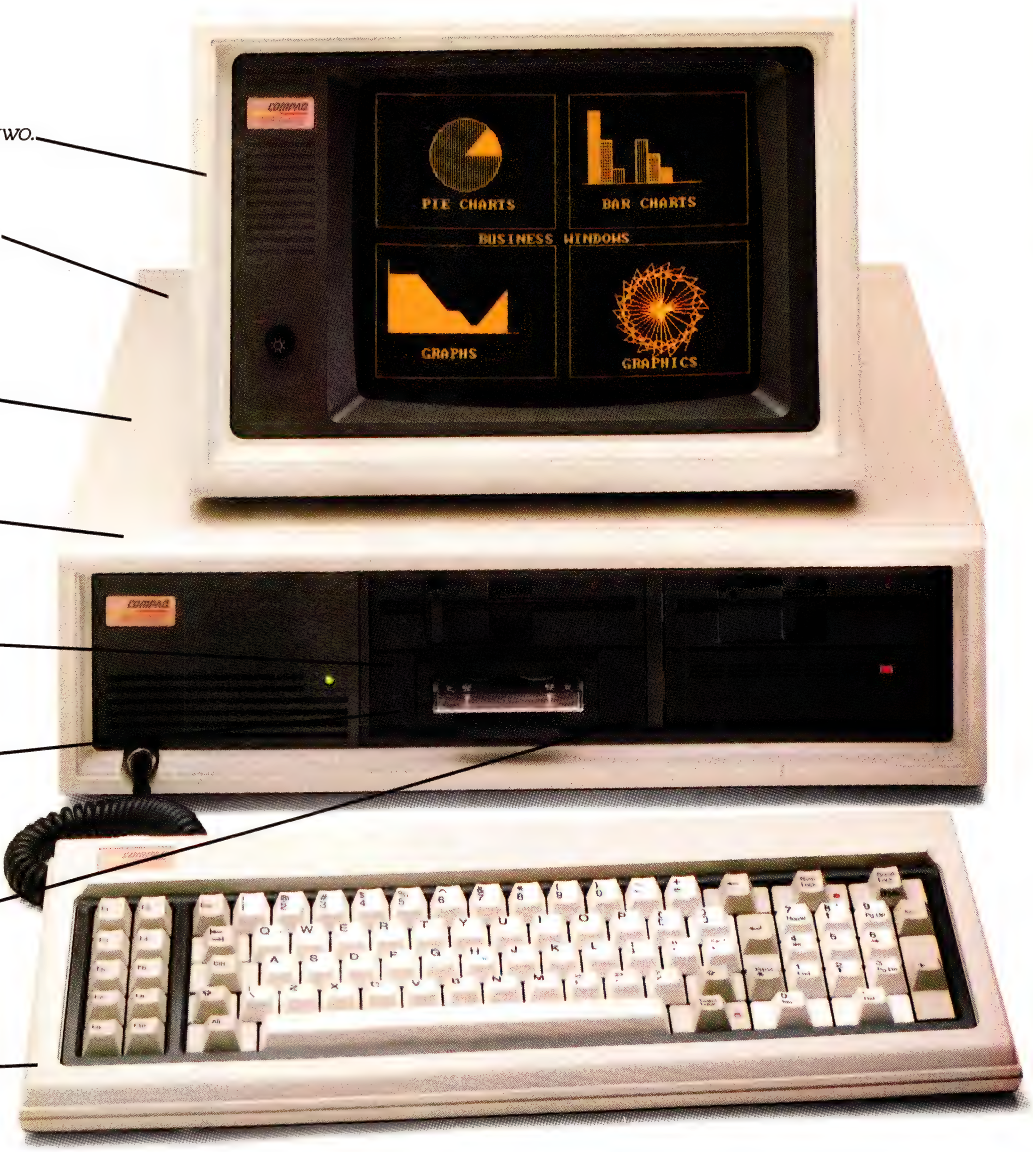

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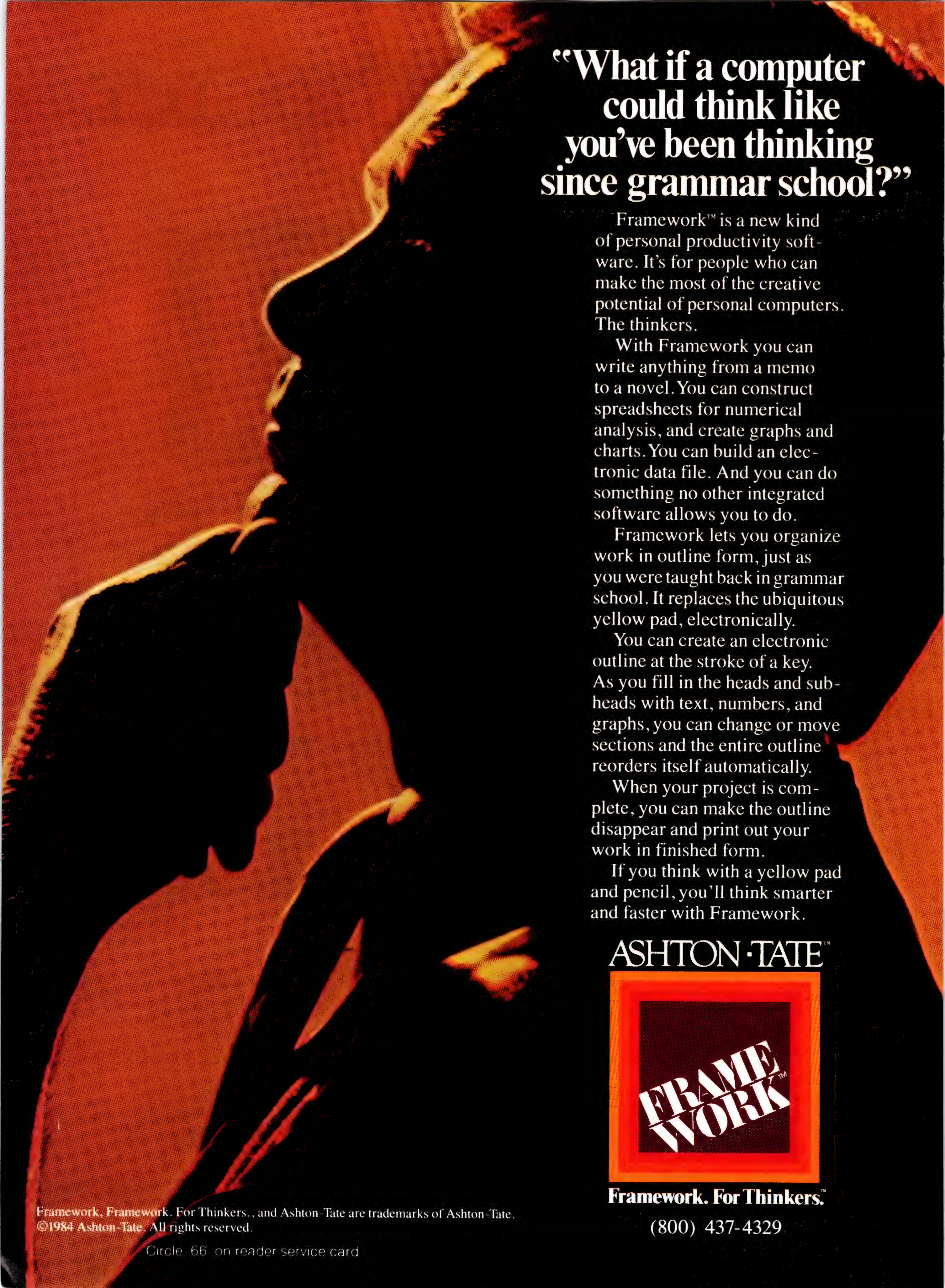

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SPECIAL REPORTS

# NEW TOOLS BOOST SOFTWARE PRODUCTIVITY

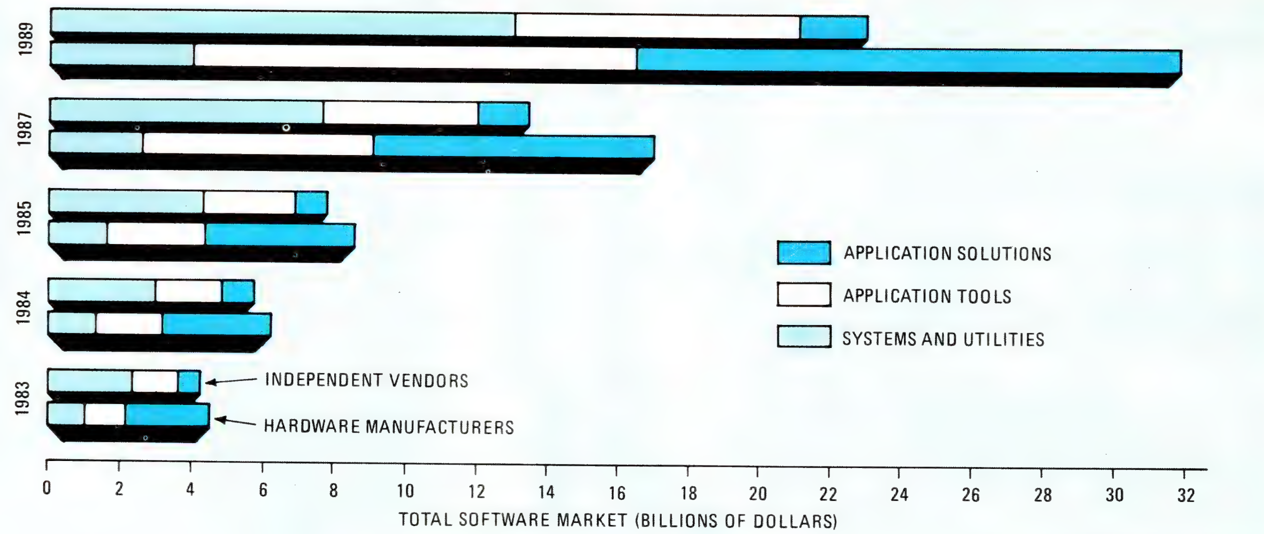
Advanced approaches are fourth-generation languages, rapid prototyping, reusable software, and computer-aided engineering tools for design and development ☐ *by Stephen Evanczuk*

In a volatile arena like software development, delays in introducing new products can be devastating. To maintain schedules during peak development periods, software project managers have relied on their ability to increase their programming staffs. But with bleak forecasts predicting increased shortages of programmers, fewer managers will be able to fall back on this traditional approach. Instead, organizations must find new methods and automated software tools that can boost the productivity of their existing software development staffs. Fortunately, a wide range of products now supports each phase of the software life cycle—from the definition of requirements, through design and implementation, and on to integration and maintenance.

The U.S. Department of Defense predicts that the current shortage of software professionals—now as high as 50,000 to 100,000 programmers—will probably rise to about 1 million by the decade's end. Consequently, the traditional option of adding staff to meet tight deadlines will probably disappear—even for organizations than can compete for expensive programming talent. Instead, managers must attempt to improve their development environments and thus increase the efficiency of current programmers, rather than add new ones.

As a result of pressures created by the shortage of programmers, the market for application-development tools, both from hardware manufacturers and independent vendors (Fig. 1), should advance at a rate even faster than that of the exploding software applications market, according to International Data Corp., Framingham, Mass. Besides conventional systems programs and utilities, such as compilers and linkers, IDC expects a surge in growth for the market for application tools, including classical program-development tools, application generators, and design aids. In fact, independent vendors of application tools can expect the market to grow by about 40% annually for the next few years, according to Ann L. Morley, a senior software consultant at International Data Corp.

Expectations for this multibillion-dollar market come



SOURCE: INTERNATIONAL DATA CORP.

**1. Billion-dollar baby.** Faced with a need to find ways of creating programs more quickly and reliably despite a shortage of programmers, software engineers will push the market for application tools to an annual growth rate of about 40% for independent tool makers.

as no suprise to managers responsible for improving the productivity of corporate resources. Many now say that they have no choice but to invest in ways to improve productivity. Differences of opinion chiefly concern how the money should be spent.

Government-sponsored programs and rapid advances in technology argue for a wait-and-see approach. But firms whose profit margins depend on their ability to produce software quickly and reliably cannot wait; they have problems now. Although they are keeping a close eye on national programs and new technology, managers responsible for productivity are already augmenting their corporate software engineering environments with alternative programming languages, reusable software, improved software development aids, computer-aided software engineering tools, and automated design aids.

## Nonprocedural languages

Since the days when assembly language replaced machine coding and Fortran compilers replaced assemblers, programming languages have had a considerable effect on the productivity of programmers. In their efforts to reach higher levels of productivity, many hardware manufacturers and independent software vendors have turned from traditional programming languages to application-specific tools built around central data bases.

Instead of specifying a series of programs with conventional programming languages, those who use this alternative follow a nonprocedural method in which they merely define the kinds of data and data transformations they must extract from or add to the data base. Typically, these methods lead users through a series of menus, or they supply programmers with higher-level application-oriented command languages, popularly called fourth-generation languages.

These fourth-generation products abound in the industry—from IBM Corp.'s SQL (for its mainframes) to Ashton-Tate's DBase series for personal computers. To satisfy end-user query and reporting requests—the primary objective of fourth-generation languages—most work off a unique data base, not a conventional production system. Burroughs Corp., Detroit, however, took a fourth-generation approach that was developed to satisfy production-class requirements, says William Maclean, the company's director of systems software.

Originally developed at the University of Auckland, New Zealand, Burroughs' logic and information network compiler (LINC) generates a production system, based on Burroughs' DMS II data base, from a specification written by LINC users. In it, they use a LINC definition language (LDL) to break applications into data components, event transactions, and profiles (various views of the data).

After this LDL specification is complete, LINC compiles it to generate not only the DMS II data base but also associated Cobol 74 application programs, an appropriate Burroughs' Gemcos communications monitor, and network support in Burroughs' Network Definition Language (NDL). From the user's point of view, LINC's ability to generate production systems means faster execution speed because the user is working with an executable image of the programs and not with an interpreter—the standard fourth-generation approach.

Gary Winter, director of marketing at Oxford Software Corp., Hasbrouck Heights, N.J., agrees that fourth-generation techniques do lose out on run-time performance, but adds their flexibility makes up for it. Oxford produces fourth-generation systems, including UFO (user files on-line) and COSS (CICS on-line security system), for on-line application development. Though final performance levels may not be optimal, Winter thinks these systems win on the broader question of productivity, or the ability to produce an application quickly.

## Rapid development

Development organizations throughout the software industry have turned to such techniques as fourth-generation languages to turn out quick-and-dirty prototypes of applications software. In fact, the movement to develop program samples has caught on so quickly that many

## Portability problems pester programmers

The large number of utilities written in C for AT&T Bell Laboratories' Unix operating system has been greatly responsible for its popularity among programmers. Although this potential wealth of C routines could aid even more programmers across a number of different computers, fundamental differences in C implementations on different machines eliminate this potential benefit. For example, while not violating the American National Standards Institute's draft standard for C, Data General's particular format for character pointers in its C compiler prevents the compilation of most C programs written for the *de facto* standard C compiler of DEC's VAX minicomputer.

The problem also plagues other machines that make similar distinctions between character and byte pointers. According to Mike Meissner, principal programmer and project leader at Data General, it is less a result of the format *per se* than of the inability of called procedures to determine what kind of pointer they are receiving. Meissner thinks that if procedure headers identify the kind of pointers a procedure uses, this problem will be eliminated—a suggestion that has already found its way into the ANSI draft standard, which is expected to be released for public review around the end of the year.

To prevent the type of situation in which seemingly small compiler differences block portability, Digital Research Inc., Pacific Grove, Calif., developed its compiler line as a set of separate modules. A hardware-independent front end transforms high-level source code into an intermediate code, which a language-independent back end analyzes to generate hardware-specific machine code. By combining the appropriate front- and back-end modules, Digital Research creates a compiler for a particular high-level language targeted for a particular microprocessor. Thus programmers can feel sure that a Fortran program, for example, will compile and run on any supported processor—whether it uses a segmented or flat address space.

organizations have added rapid prototyping to their list of approved development policies. Rapid prototyping bypasses specification and directly builds sample versions of a program's critical parts.

In a study that compared prototyping approaches to the conventional specification method, Barry Boehm, chief engineer of TRW Corp.'s Software Information Systems Division, Redondo Beach, Calif., found that prototyped products yielded performance levels comparable to those of specified products but with about 40% less code and 45% less effort. Although the prototyped products were also easier to learn and use, they were less coherent than their specified counterparts and harder to integrate into complete designs. In addition, Boehm says, prototyping kept the design focused on the problem's salient features and away from bells and whistles.

Prototyping seems to fly in the face of techniques for conventional large-scale software development—particularly in DOD contracts, which require heavily detailed documents at each stage of a project's life cycle. In fact, prototyping can actually complement conventional specifications. Instead of concentrating only on formal specification or on rapid prototyping, says Boehm, "you really ought to use a mix. And the mix is driven by a risk assessment. If there is a big risk that you may not get the user interface right or that some algorithm will not work in real time, it's worth investing in a prototype."

As part of its own campaign to boost productivity through its development center concept, IBM's Information Systems Group, Rye Brook, N.Y., notes that prototyping is an effective means of involving users in the early stages of product development—when a mistake is 100 times less costly to correct than it is in the final production phase. Software developers working in the development center environment can draw on IBM's Interactive System Productivity Facility, which includes menu-driven aids for program development and data handling, and on its line of application generators.

One of the virtues of application generators, says IBM, is that they supply pretested logic for applications. In fact, the idea of using precoded and pretested pieces of programs has been an unfulfilled dream of software-development managers for a number of years. In some cases, software houses have managed to augment their software-development capabilities by building libraries of commonly used functions and programs.

Further, some products include libraries of low-level routines, sparing programmers the need to recreate certain procedures for such common operations as input/output and data-format conversion. For example, Softool Corp., Goleta, Calif., includes a library of Fortran modules for data manipulation, reading and finding records, and function calls in its productivity tools.

### Play it again

Although these code libraries enhance productivity, an even more significant development will be the widespread reuse of program architecture and software designs. Reusable architecture has been neglected for the most part, although some help should come from Ada, with its package concept and explicit separation of the specification and code sections of programs. About the only software that reuses program designs are systems packages, such as operating systems, compilers, and data bases. These system programs can reuse designs mainly because their basic functions are well known and generally constant. Still, business applications share some of these same characteristics.

"The industry recognized that some 35% to 40% of all programs ever written were report programs, so you saw things like report generators come out," says Larry Martin, president of Master Software, Watertown, Mass. "But interestingly enough, if you look at the next most common function in business applications—updates, which account for about 20%—you have over half of a system. Yet there are no update generators."

In fact, studies at Burroughs and Raytheon Co., Lexington, Mass., have found that some six functions—edit, sort, report, update, combine, and explode—account for 80% to 85% of all business applications. Master Soft-

## Finding a yardstick for productivity

Most software engineers agree the productivity means more than how many lines of code an individual programmer can produce, says Eleanor Antreassian of Computer Sciences Corp., Piscataway, N.J. Antreassian heads the IEEE's newly formed working group for software productivity measures. Although the group has met only twice, she says it has already decided that it will look at project, not individual, productivity.

Ron Willis, technical director of a software engineering productivity program at the Hughes Ground Systems Support Group, agrees that productivity must encompass more than lines of code. Willis says that when he looked at Hughes's 73 procedures for dealing with software, he found that of the 370 products generated for a software project, only 10% are related to lines of code. "It's like taking a Saturn II rocket, counting the rivets, and using that to figure out how much effort went into the production of the rocket," he says.

Still, a rivet count gives some measure of the technology that went into the rocket's production—such as the product's size and the number of plans involved in the design, Willis notes. But the lines-of-code yardstick is apt to be around for a while. "As bad as it is, it is a *de facto* standard. It's still the only way we have to compare companies."

ware's PrograMaster combines these functions for business applications. Martin says, however, that PrograMaster goes beyond a static collection of reusable modules. "What we have done is to put together a reusable program design with functions that can be dynamically accessed by a system. So what you have is a single program structure that can be used for all programs."

Programmers use PrograMaster to build an application through a series of steps, starting with its profile, or basic activity, such as edit, sort, update, report. PrograMaster uses this profile to pose a series of questions—for instance, what kind of sort is desired. Armed with the user's answers, the system develops the particular application program. According to Martin, Master Software is already producing systems with 2 million to 3 million lines of code.

Reusable modules, designs, and architectures, in view of their ability to boost programmers' productivity, have barely scratched the surface of the software development market. Paul Maritz, manager for software tool planning for Intel Corp.'s development systems operation, in Santa Clara, Calif., suggests at least two reasons why reusable software has not become more common. "How do you specify what a module does, without having to read the code?" he asks. Before reusability can reach its full potential, some method must be found to concisely represent a module's function. Furthermore, says Maritz, "given a module with, say, 90% of the function you need, how do you modify a reusable module?" Although Ada may relieve the latter problem through its packages, modifying reusable modules could create headaches for program developers.

### Programming environments

Such concepts as reusability will no doubt be extended from specific applications, such as those for business, to become key productivity aids in future general-purpose software engineering environments. For now, planning managers such as Maritz must expect to augment the capabilities of conventional programming environments. Already available for a wide variety of systems, software development systems have a wide range of capabilities, ranging from support for general software development to support for specific languages, such as Ada.

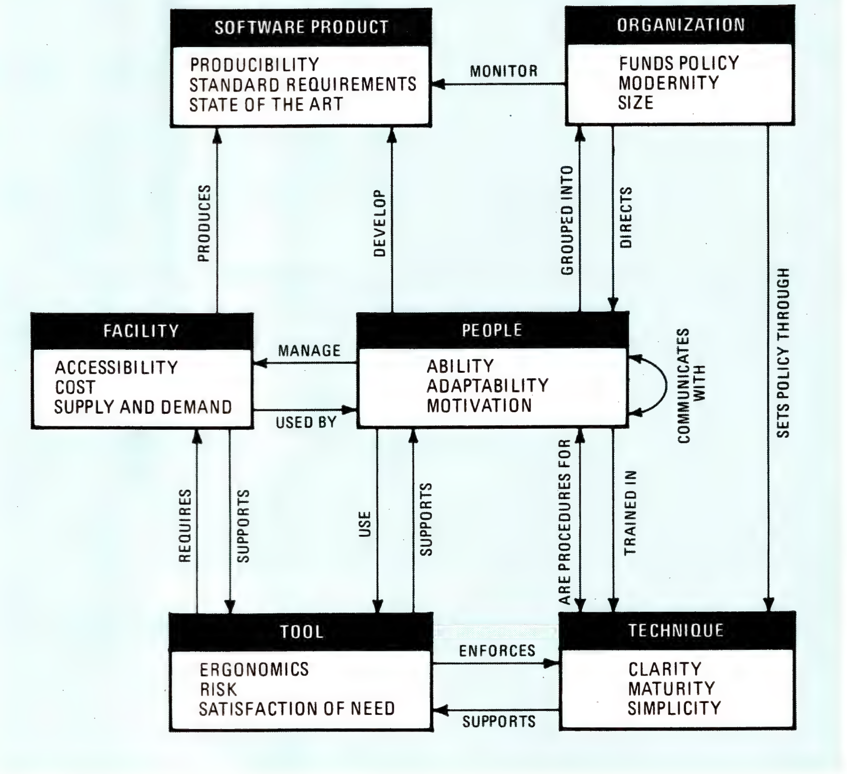
One of the better-known development environments has emerged around AT&T Bell Laboratories' Unix operating system. Besides the indirect programming aids afforded by Unix's run-time support for piping, Unix has earned much of its glory for its vast library of C programs; these have been ported to a variety of machines, although with varying success (see "Portability problems pester programmers," p. 69). The Unix environment also provides some help in managing the logistics of large-program development. A pair of Unix utilities, the source control and configuration system (SCCS) and Make, help programmers keep track of different versions of source code and generate a current version of a large program from individual modules, respectively.

Unix is hardly the only operating environment that has won the hearts of programmers using Digital Equipment Corp. VAX minicomputers. Many software developers consider DEC's VMS superior to Unix, says Don Baccus, president of Oregon Software Inc., Portland, Ore. "Individual Unix tools tend to be mediocre but linked nicely together. Individual VMS tools tend to be better." Though Oregon Software has built its reputation on its various compilers for different operating environments, it has moved strongly into the VAX VMS market with the release of SourceTools—a program development environment it used internally for several years to develop its software.

Besides its SourceCon and Make—similar to Unix SCCS and Make—SourceTools includes help for programmers developing programs that are then downloaded into some other system. For this cross-development environment, SourceTools' Txtcom and Sedit maintain parallel source files on the host and target systems. Txtcom produces a list of differences between source files, and with Sedit, SourceTools' stream editor, it can be used to update files on different systems.

Source-control utilities such as SCCS and Make are vital tools not only for the typical multiuser environments running on minicomputers but also for single-user work stations that share resources through networks. Built up from its series of Intellec work stations, Intel's network development system and network resource manager let software developers tie into one another's efforts.

To manage this type of multiuser environment, Intel offers a Unix-like software version control system (SVCS) and Make utilities to complement a set of development aids ranging from editors, compilers, and linkers to debugging aids. Engineers who debug software for



**2. Not just tools.** To create the most effective software engineering environment possible, organizations will need to integrate all their resources—products, facilities, and tools—and account for all types of information flow among their different parts.

embedded microprocessor systems haven't earned their share of attention, says Intel's Paul Maritz. "For many of these developers, the target system may likely be different from the development system. When you have discontinuities in the development environment, things get complicated."

Intel addresses this area with a source-level debugger called Pscope and an integrated instrumentation in-circuit emulator (I$^2$ICE). To smooth the transition from the development to the target environment, I$^2$ICE and Pscope share the same interface for debugging.

For engineers developing microprocessor-based systems, Intel's tools for help with its family of microprocessors share the limelight with development systems for a broad mixture of central processing unit chips. For example, the Model 64000 logic development system [*Electronics*, May 5, 1983, p. 117] from Hewlett-Packard Co., Palo Alto, Calif., addresses development problems from design to integration. Besides the conventional development aids, the Model 64000 helps developers tune into a system's problems with its software performance analyzer, which reports on a variety of system parameters, such as activity on an emulation bus, memory usage, and event duration.

Besides its own support for general-purpose development of microprocessor-based systems—through its 8500 series development tools—Tektronix Inc., Beaverton, Ore., pitches in with support for Pascal development with its Pascal Language Development System (Lands). As an add-on to Tektronix's 8560 software development lab, Lands combines a Pascal-specific editor and compiler with a set of tools that help developers integrate Pascal programs into hardware systems. For example, a real-time debugger helps programmers check Pascal code at the source level as it executes in an emulated target machine.

This kind of development support for specific languages has found champions for a wide variety of languages, including Cobol, Ada, Modula-2, Lisp, and Smalltalk. One unique approach, from SoloSystems Inc., San Jose, Calif., uses a multitasking work station for Cobol development. SoloSystems packs various editing and debugging aids along with a Cobol compiler into its desktop 1116 SoloStation. Concurrent with program development and testing, programmers can transfer programs between the work station and larger machines using SoloStation's file-transfer capability, and work through its terminal-emulation features.

If the DOD gets its way, Ada programmers can also expect a sophisticated development environment designed for this new language. As part of its Ada program, the DOD will define Ada programming support environments. Though a complete APSE is not likely to be seen in the near future, intermediate environments will incrementally provide various degrees of support.

For example, in November, Intermetrics, Cambridge, Mass., plans to deliver the Ada programming environment that it has been developing for the Air Force. A contract option provides for the development of a more substantial programming environment, including a database facility and an Ada-specific editor, says Michael Ryer, director of the company's Ada Systems Division.

Along with Rolm Corp., Santa Clara, Calif., Data General Corp., Westboro, Mass., is marketing an Ada development environment around the Ada compiler that passed the DOD's annual certification twice in two years. It runs on Data General minicomputers and Rolm's militarized versions of these machines. The development environment includes the software developer's conventional tools, such as a command-line interpreter, a configuration manager, an editor, a validated Ada compiler, a linker-loader, and a source-level debugger.

For special environments revolving around such languages as Lisp, Modula-2, and Smalltalk, programmers can find support from Niklaus Wirth's Lilith machine (for Modula-2) and from machines that run Smalltalk, such as the Xerox Corp. Dorado, with its Cedar programming environment, developed by the Xerox Palo Alto Research Center. In general, these machines are developed and employed by sophisticated computer scientists, so their users usually enjoy rich development environments—a condition most notable for Lisp. Computers

## The IEEE takes a crack at standards for software engineering

To ensure product differentiation, companies sometimes sidestep standards efforts. Still, organizations will likely jump on the standards bandwagon if they are involved in developing critical software, whose failure could cause serious social or financial losses. Until the IEEE started its software engineering standards effort, a suit over the failure of critical software could not be decided with reference to a "standard blessed by a voluntary consensus of a standards-making organization that said what reasonable and prudent people should do in building software," says Fletcher J. Buckley, at RCA's Missile Service Radar Division, Moorestown, N.J. He also serves as vice president of standards activities for the IEEE's software engineering technical committee.

"We're not out there beating the drum saying, 'You got to do this,' " notes Buckley. "We're saying these are standards that a voluntary consensus of concerned professionals in the field have established as a minimum subset of things to be done when you're developing critical software."

Besides a number of ongoing projects, the 2,000-member standards effort has already developed five standards, available from the IEEE Service Center in Piscataway, N.J.

| STANDARDS | |
|---|---|
| ANSI/IEEE STD 730 (1984) | software quality-assurance plans |
| ANSI/IEEE STD 729 (1983) | glossary of software engineering terms |
| ANSI/IEEE STD 829 (1983) | software test documentation |
| IEEE STD 830 (1984) | software requirements: specification guide |
| IEEE STD 828 (1983) | software configuration-management plans |

| NEW INITIATIVES | |
|---|---|
| No number | guide for third-party software acquisition |
| No number | software quality metrics |
| No number | user documentation |

| APPROVED PROJECTS | |
|---|---|
| No. 982 | software reliability |
| No. 983 | software quality-assurance guide |
| No. 990 | guide for the use of Ada as a program design language |
| No. 1002 | software engineering standards taxonomy |
| No. 1008 | software unit testing |
| No. 1012 | software-verification plans |
| No. 1016 | guide for software design descriptions |
| No. 1028 | software reviews and audits |
| No. 1042 | guide for software configuration management |
| No. 1044 | classification of software errors, faults, and failures |
| No. 1045 | software productivity metrics |

such as those from Lisp Machine Inc., Los Angeles, offer extensive development support on work stations augmented with special-purpose hardware that speeds Lisp execution.

Development tools for program coding may form the foundation of software engineering environments, but not the whole. "I've spent the last three years telling people that productivity isn't just tools," says Ron Willis, technical director of a software engineering productivity project at Hughes Aircraft Co.'s Ground Systems Support Group, in Fullerton, Calif. "They can help individual programmers produce code faster, but a more effective measure of productivity must take into account the broader picture—the development of reliable programs."

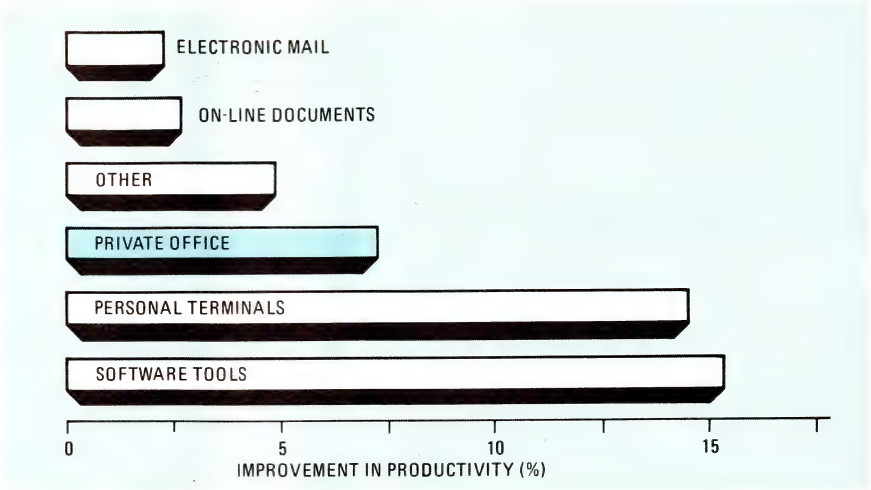
To boost productivity, software experts who study different development strategies realize that they must step back from lines of code and look at the entire software engineering environment (see "Finding a yardstick for productivity," p. 70). The traditional triad of technology—industry, government, and academia—clearly recognizes the need for integrated software engineering environments. The exact specification of the optimal environment eludes the experts, however.

Nevertheless, like their counterparts in hardware development [*Electronics,* May 17, 1984, p. 121], software managers recognize that a fully integrated software development environment must reach into every part of an organization. Willis points out that this need embraces both concrete resources—products, facilities, and tools—and more abstract procedural considerations (Fig. 2).

Recognizing the importance of software, the DOD hopes to establish a consistent environment through two major programs, Ada and Stars (software technology for adaptable, reliable systems). As the software analog of its Very High-Speed Integrated-Circuits program, Stars seeks to develop an integrated and automated software environment that spans the entire software life cycle.

Within the Stars program, the DOD will establish a project called the Software Engineering Institute, which will serve as a central clearing house for information about software engineering tools and techniques. Though the institute's charter remains unclear, it may work at least implicitly to define standards—an area the Institute of Electrical and Electronics Engineers has already begun to address (see "The IEEE takes a crack at standards for software engineering," above).

Even though results are slow to appear, perhaps the most significant software development over the last two or three years is this growing commitment to develop an integrated software engineering environment. Although a full computer-aided software engineering environment is still some years away, current efforts in this area are



**3. Many components.** When TRW surveyed programmers involved in its productivity effort, it found that they regarded a number of different elements as important in enhancing productivity. No single component—not even the physical environment—stood out.

ranging from commercial products to internal research and development projects.

Such organizations as DOD contractors TRW Inc.'s software unit in Redondo Beach, Calif., and Hughes depend on their ability to produce large software systems reliably and quickly. Both these major software firms have poured internal funds into large-scale efforts to improve productivity. In addition, both are well into five-year projects aimed at halving their costs—whether phrased as TRW's "2x increase in lines of code produced" or as Hughes's "50% improvement in productivity and quality."

TRW's software productivity project carefully examined several aspects of the programmer's environment—its ergonomics, for instance. After experimenting with various configurations—including one-, two-, and three-person offices—TRW established a single-person 90-ft$^2$ office as its base line. Because programmers indicated that the physical aspect of the environment was only one part of the whole picture (Fig. 3), TRW is not renovating existing buildings but including these personal offices in its new buildings in California, Virginia, and the District of Columbia.

Barry Boehm of TRW explains that even though seemingly minor details such as the programmers' working environment do not appear in software cost models, these considerations are very important to an organization's overall technical capability. "The model says that the biggest leverage comes from all the people variables. Whether you're doing the job with extremely good people or with mediocre people can make a factor-of-four difference in productivity. A lot of the things that we've been doing have been done to try to attract the best people."

Although he agrees that the environment is a key ingredient to success, Hughes's Ron Willis points out that a clear description of software requirements goes a long way toward improving productivity. "You have to improve the interface between the systems engineer who produces the spec and the software engineer who produces the product." Hughes already has built a tool to streamline this interface: its Systems Engineer Work Bench, which automatically analyzes documents for consistency and completeness.

### Integrated environments

Contract shops such as TRW and Hughes have mostly confined their efforts to the supply of tools for internal software development strategies. On the other hand, independent software vendors, such as Nastec Corp., Southfield, Mich., think that stand-alone packages for computer-aided software engineering can address the general needs of the software environment. The key to success here is to focus on general needs. "We felt that it was absolutely necessary to be general enough to accommodate any design technique or methodology because there is no consistency out there," says Richard L. Ramsdell, senior vice president at Nastec.

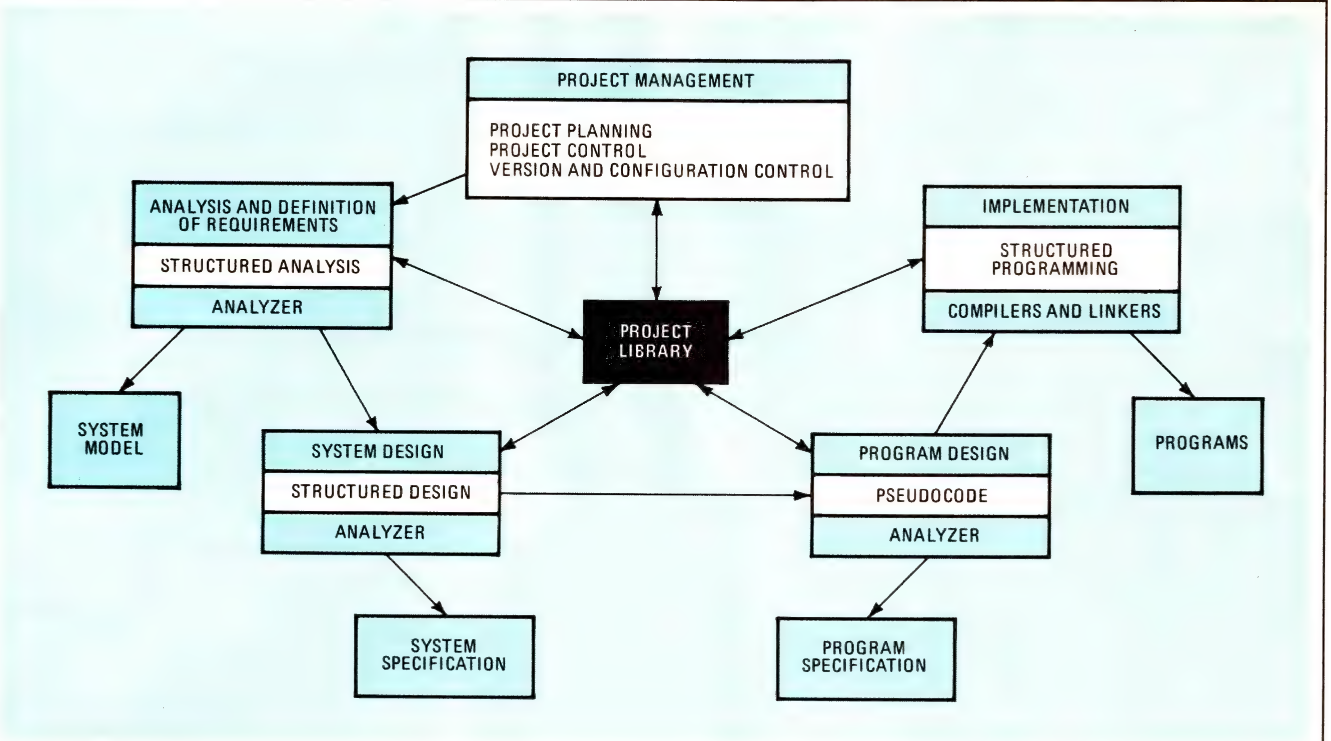
Nastec bundles general software tools for the engineering cycle with clusters of Convergent Technologies work stations, which execute CTOS, the Santa Clara company's proprietary real-time multitasking operating system. Besides general support for design methodology, Nastec supports the needs of management with its LifeCycle Manager, which replaces manual scheduling and tracking procedures with an automated one.

In ProMod (Fig. 4), an extensive package for the software life cycle, Gesellschaft für Elektronische Informationsverarbeitung (GEI) MGH, Aachen, West Germany, arranges support utilities around a central project library. Designers can draw on the package's support for structured analysis and modular design. They share information about a system with programmers, who use the system's compilers and linkers, as well as with managers, who use the system's tools for project planning and control. The Pascal-based system currently runs on DEC's VAX VMS and PDP RSX systems, with versions planned in the near future for the IBM Personal Computer and for Unix-based systems.

Besides these tools for the software life cycle in general development environments, others support the life cycle in specific environments, such as those in DOD contract shops. Working through the maze of documents required in government contracts can be tedious at best and almost impossible to do by hand, says Jim Schaffer, vice president at Computer Science Innovations Inc., Satellite Beach, Fla. Schaffer's company came up with an automated method for handling the extensive documentation and tracing requirements required in these contracts.

The company's Computer-Aided Lifecycle Management (CALM) package produces appropriate documentation for each of the six phases of the project life cycle—definition, requirements, design, implementation, integration and verification, and on-site operation. Much of CALM's power comes from its underlying base, built on a problem statement language and an associated problem statement analyzer, PSL/PSA.

Originally developed at the University of Michigan,



**4. Project model.** The integrated software engineering environment from GEI, a West German company, provides tools for separate phases of the project life cycle. A central project library provides the key element that integrates the tools into an environment.

PSL/PSA includes a powerful relational capability but is considered difficult to use. "PSL/PSA is a set of tools for describing things—it doesn't lock you into a methodology," says James Worthman, who directs Computer Science Innovation's advanced methodology department. "That's where CALM comes in. We have surrounded PSL/PSA with a methodology, among other things."

Tools such as Nastec's work station or Computer Science Innovation's CALM package provide design analysts with a general framework they can mold to match their own working methods. In addition to these more general aids, a number of firms offer tools that support one of the many specific methods available to system designers. These systems have been designed to use specific formal methods to improve the quality of specification documents.

Conventional specification documents rely on their writers' narrative ability to convey information about a system's capabilities. Several commercially available systems have rescued the specifications stage from its dependence on narrative description by using a graphics-oriented approach that explicitly details various system functions and components.

Isdos Inc., Ann Arbor, Mich., which spun off from the University of Michigan to market PSL/PSA, now also supports one formal technique, the structured analysis method, with a tool called PSA/SA. Announced in June, PSA/SA acts as a specific support environment for the firm's more general PSL/PSA package. Because the structured analysis support package rests on top of PSL/PSA, it runs on any machine that runs PSL/PSA, including IBM mainframes and DEC VAXes running under VMS.

Furthermore, the structured analysis interface—the first of the three major components of PSA/SA—runs on IBM, DEC, and Tandy personal computers. Analysts can thus develop designs on microcomputers and transport the information to a large machine for later analysis, says Joe Oates, the marketing manager at Isdos. The last two components provide a set of analysis procedures based on DeMarco rules and a document generator that produces structured specification documents.

Higher Order Software Inc., Cambridge, Mass., supports the design process by using its own theory of systems, formulated as a result of the experiences of company president Margaret Hamilton when she managed the development of on-board software for the National Aeronautics and Space Administration's Apollo project. With the firm's first product, Use.it, designers can interactively create specifications from requirements. Thanks to the underlying theory, it can find ambiguous data and timing relationships and produce logically error-free specifications from the requirements, she says.

Specific support for design is now appearing from vendors whose mainstays range from fourth-generation approaches—such as Software Express Inc., Houston, Texas, whose application-generator package, Appgen, supports structured design—to conventional development systems—such as Tektronix structured analysis tools that support structured analysis [*ElectronicsWeek*, Aug. 20, 1984, p. 69]. Besides these U.S. firms, design support shows up worldwide for a number of different operating environments. For example, for VAX VMS and Unix-based systems, Institut de Génie Logiciel, Paris, France, offers its Specif—a graphics-oriented tool for support for IDEF0 and SADT, the structured analysis and design technique from Softech, Waltham, Mass. ☐

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*Stephen Evanczuk is a contributing editor of this magazine.*

# DIGITAL ICs TO BRIGHTEN VIDEO PICTURE

An advanced video display processor puts television at the center of the next generation of home information systems ☐ *by Mark Kisner and Jean Ladd*

With a bit of help from a new kind of very large-scale integrated video processor and the huge data bases now being assembled for videotex, the everyday TV receiver is about to become the linchpin of a new information era. The technology that will take TVs out of the era of entertainment and into the information age is the same one already responsible for video games, home computers, videotex, and teletext: microprocessors, memory, and a relative newcomer, the video display processor.

Recently, Texas Instruments refined the video display processor it designed to support the North American Presentation Level Protocol Syntax standard for videotex and teletext. This new chip has been dubbed the Advanced Video Display Processor, or AVDP.

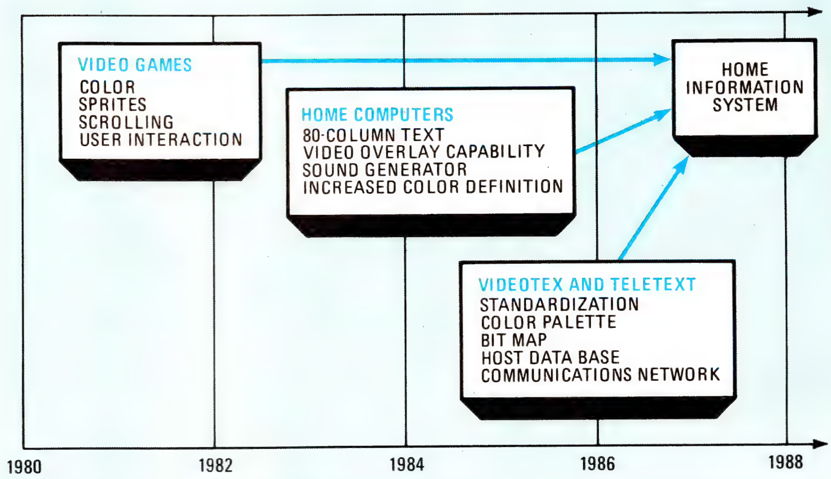
## A scenario

Every computer buff knows that TV receivers can do more than merely reproduce the commercial programs transmitted over the airwaves. A few years ago, when the first video games appeared, manufacturers held costs in check by using home TV receivers as the display vehicle. With the introduction of home computers, the same scenario was played out again: Users saved money by employing their TV sets for display. And with the coming of the third wave of computer-video technology for videotex and teletext, home TVs will once more provide the visual medium.

From the late 1970s onward, random-access-memory chips had the density required to store image information for TV displays. Today's RAMs have up to an order of magnitude more storage capacity and can hold all the data needed for color picture descriptions, updating information on screen, and handling animation. In fact, with current-generation 64-kb RAMs, storage for the entire bit-mapped TV display is available, and enough memory space remains to allow the central processing unit to store the information it needs to control the entire video system.

Dramatic improvements have also tranformed the microprocessors that act as CPUs providing the intelligence, control, and screen manipulation for video systems. As video processor controllers, 8-bit microprocessors are cheap solutions with enough punch for a variety of video tasks. Increasing the speed and throughput for sophisticated graphics is a job for 16-bit microprocessors. At the moment, however, their 8-bit counterparts have a cost advantage that is keeping them alive for price-sensitive consumer applications.

Video display processors have simplified the problem of keeping system costs down and given 8-bit microprocessors the help they need for complex video tasks. These functions can be performed by a microprocessor tailored for graphics, but it is more efficient and cheap-



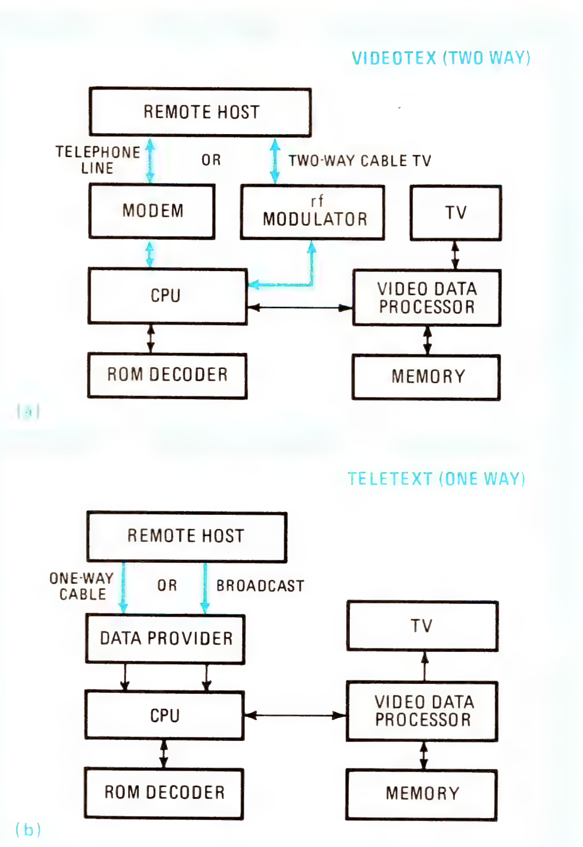
**1. Electronic evolution.** Low-cost consumer electronics systems are gaining sophistication. Home computers have displaced video game consoles, and before the decade's end, home information systems will replace home computers.

er to use a dedicated chip optimized for such cycle-intensive chores as timing and memory refresh, video timing, video display refresh, and the conversion of digital signals to the analog form that TV receivers require.

These chips are a relatively new breed of processor. Although they have been on the market for just a few years, they have been used in U.S.-made TV sets, which use a standard 525-line format, and in sets that use the 625-line format of Europe's PAL system.

Low-cost video systems will become increasingly important because videotex and teletext can bring extensive computer-graphics-oriented application data bases into individual homes. Now, for example, users have access to the vast assortment of programs for home and personal computers. As videotex and teletext proliferate across the country, TV sets will also be incorporated into the home information systems that lie ahead.

TV has been evolving into the focus of such systems—offering both graphics and text support—since the early 1980s, when relatively simple computer games appeared (Fig. 1). Mid-decade will probably go down as the era of home and personal computers—a trend that will probably last well into the 1990s.



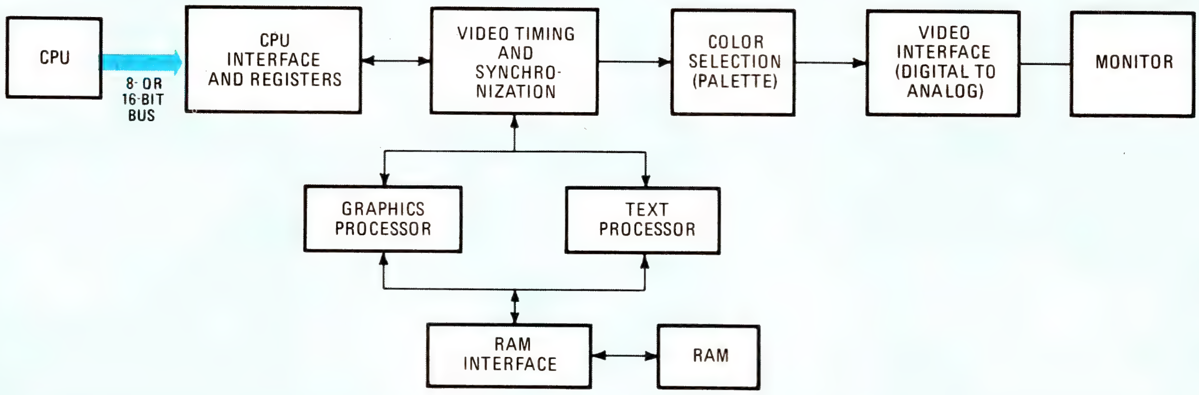
**2. Two foundations.** Videotex and teletext will form the foundations for the coming generation of home information systems. With videotex (a), users can interact with a variety of computer data bases, while teletext (b) is essentially noninteractive.

The wave of the future is the use of TV for videotex and teletext, giving just about anyone access to data banks containing business, banking, shopping, educational, and other kinds of information, such as news. Mature home information systems, which are probably a few years away, will incorporate this transaction capability with all applications that use TVs for display. They will be a communications and video-display home appliance serving just about all entertainment, education, and business needs.

With each incremental upgrade in system capability—from games to computers to home information systems—comes a corresponding need to upgrade the power of the video system. Video games require graphics that can support such animation capabilities as scrolling and sprites, the special kind of animation that permits the screen and multilevel pattern to move smoothly. User interaction is generally simple, often involving nothing more than a joystick.

With the advent of home and personal computers, a much higher level of human interaction was required to handle text, so keyboards replaced joysticks as the user input device. Good personal computer systems must be able to provide 80 columns of text on screen and should also offer such features as graphics overlay, enhanced color graphics, and sound for games or user interaction.

As the name implies, a graphics overlay increases the amount of information that can be presented on a single


CPU
8- OR 16-BIT BUS
CPU INTERFACE AND REGISTERS
VIDEO TIMING AND SYNCHRONIZATION
COLOR SELECTION (PALETTE)
VIDEO INTERFACE (DIGITAL TO ANALOG)
MONITOR
GRAPHICS PROCESSOR
TEXT PROCESSOR
RAM INTERFACE
RAM

**3. Video integration.** A generic video system operates under the control of a central processing unit to generate graphics and text images on a TV screen. Except for the random-access memory, all functions shown can be incorporated into a single chip.

screen, so computer-generated images can appear over a live video signal. Text, for example, can be added to a picture while the picture is being displayed, an important feature in educational and information systems. To do all this, the video system must be powerful enough for two different kinds of data to share the same display area.

SYSTEM EVOLUTION: TECHNICAL CHARACTERISTICS

| | Video games | Home computers | Home information systems |
|---|---|---|---|
| Processor (bit size) | 4 or 8 | 8 | 8 or 16 |
| Memory (K bytes) | 2 to 40 | 8 to 64 | 64 to 128 |
| Innovation | joystick | keyboard | remote data-base communication |
| Video | | | |
| colors | 4 to 16 | 8 to 16 | 16 to 512 |
| pixels | 256 by 192 | 256 by 192 | 256 by 210 |
| drawing access time ($\mu s$) | <10 | <5 | <1.5 |
| Display image | block | block or bit map | bit map |

Making TV the focus of home information systems means getting it ready to handle videotex and teletext. Because the system must be able to carry on communications services with a host computer, upgrading present video systems for videotex will require the addition of a modem, more memory, and new video display processors. The subscriber's system connects to the videotex remote computer through the modem on the telephone lines. Although telephone transmission has predominated, cable TV is being tested as another possible delivery system (Fig. 2a).

Teletext requires the same video system components as videotex—CPU, memory, and a video-display-processor chip—but is a noninteractive system that uses either broadcast transmission or cable distribution. Teletext data is transmitted during the vertical blanking interval, the TV receiver's flyback time (Fig. 2b).

Both videotex and teletext have been designed around NAPLPS, so all data services in a communications network can be standardized. Services that require the interactive capabilities of videotex include airline- and hotel-reservation systems, home banking, the buying and selling of securities, and home shopping. As most cable-TV subscribers already know, teletext is more suitable for news, weather, and sports information; stock market reports; and advertising.

## The technology factors

If digital devices are to meet the challenge of the home information era, they must keep pace with the march of computer-video technology (see table). To handle the data processing and video-display loads of home information systems, 8- or, preferably, 16-bit microprocessors must replace the 4-bit chips that were adequate in the video-game days. Video display processors, which then typically operated with CPU access times of 10 ms, now have 5-ms access times, but to meet the needs of home information systems, access times must be cut still further, to 1 or 2 ms.

Users need two things out of enhanced computer graphics: more and varied colors, and higher screen resolution. In a raster-graphics system, such as a standard TV receiver, both the bit-mapped and table-driven approaches create images on screen. With the bit-mapped method, every pixel is defined independently by digital data stored in memory. Table-driven systems use a series of look-up tables stored in memory to define specific patterns on screen.

To produce text, the table-driven approach, a font-type orientation, is adequate. But to display sharp graphics images, the pixel must be associated with the data that defines its color. Bit mapping is therefore mandatory for enhanced graphics.

Both bit-mapped and table-driven graphics can expand color capabilities by using a color palette: dedicated memory that provides additional color information. For example, 512 color options can be specified in a NAPLPS video system. From this selection, the user can choose 16 colors for display at any one time. Because they can be shadings of the same color or very different colors, the palette system offers a far richer presentation than other techniques do.

## Falling prices

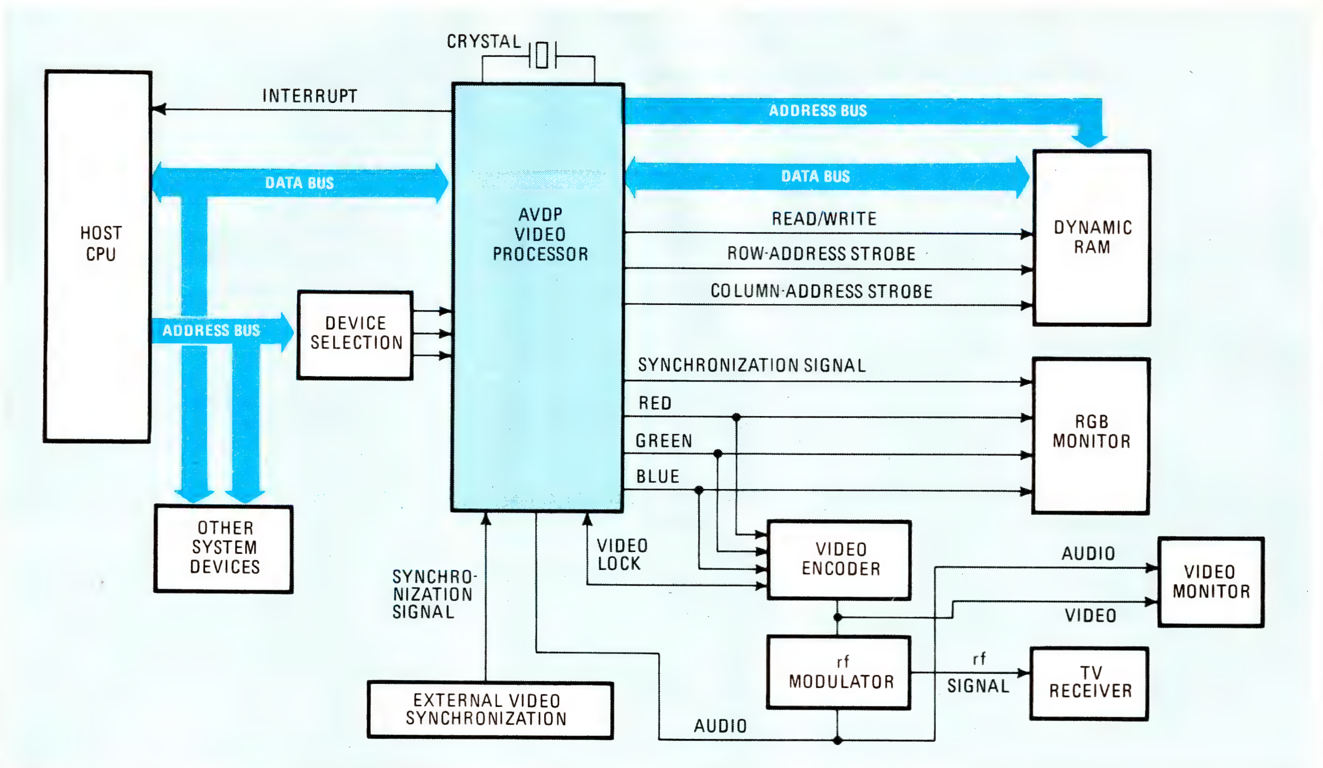
Retail prices of popular consumer electronics systems have dropped, and—because cost reductions follow large-volume sales—most of the reduction can be attributed to the integration of system functions into LSI digital components. As the prices of consumer electronics products fall, those products tend to become obsolete.

For example, the drop in home computer prices has nearly eliminated video game consoles as consumer products, because the more powerful machines offer all the capabilities of the less powerful ones, plus many more, at an only slightly higher price. In the same way, home information systems will supplant home computers by providing computer functions plus videotex and teletext. Of course, the development of advanced CPUs, memories, and video display processors is the driving force behind this increase in functionality.

One way to reduce the components costs of video systems is to combine the functions of the TV display controller and its supporting logic in a single VLSI chip, as TI has done in its AVDP. To understand how this was accomplished, consider the elements of a video system (Fig. 3).

Usually, a video system's CPU, memory, and supporting logic occupy an entire printed-circuit board costing several hundred dollars. Working through an 8- or 16-bit bus, the CPU must accommodate an interface that accepts the information and stores it in registers. This data forms the video system's instruction and data base. The CPU interface and registers contain circuitry to permit handshaking, or control of operations between the CPU and video system.

The video system controls the timing and synchronization of the vertical and horizontal display of information on screen. To ensure that the information winds up



**4. Advanced chip.** Except for RAM, all the necessary functions have been integrated into the Advanced Video Display Processor chip. This single-chip controller operates with the system CPU and video memory to generate images for a raster-scan display.

at the correct position on the display, the graphics and text processors maintain a correlation between the data to be displayed and its screen location. Because graphics processing is essentially random, it is handled on a pixel-by-pixel basis in an endless variety of combinations.

Text processing, however, is pattern-oriented and can be defined as a predetermined array of block figures—letters, numbers, punctuation marks, and so forth. The bit-mapped approach is the most efficient way to handle the complete variability of graphics data, while the predictability of text management is better suited to the block-format table-driven method.

RAM is dedicated to storing information for the display, including pattern and color descriptions. The CPU, which defines the data stored in RAM, is responsible for the video system's overall intelligence and data. After the information to be displayed has been assembled, color can be added with the color-palette technique.

The video interface is a complex function and has more roles than just a simple digital-to-analog converter. Video monitors typically accept video in the form of composite video or a red-green-blue system. In addition, different standards govern these interfaces. For example, the NTSC (National Television System Committee) format is the standard in the U.S., and PAL in Europe. Depending on the type of display to be driven, video systems use somewhat different functions; the color-encoding circuitry of a composite video system is different from that of an RGB system, much as NTSC and PAL are different.

In replacing a separate controller and its associated support circuitry, the AVDP chip can act as the heart of a complete video system (Fig. 4). TI's AVDP is one of the few chips of its type that is NAPLPS-compatible, and it also has a variety of other applications.

Basically, the chip was designed to control a raster-scan display and its video image, which is stored in dynamic RAM. The AVDP can support a display of 256 pixels (horizontal) by 210 pixels (vertical) in the bit-mapped mode. It displays up to 16 colors selected from its internal 512-color palette and handles text through its 80-character-by-25-line text mode. In addition, a special high-resolution table-driven graphics mode has been incorporated to provide a display-screen resolution of 512 by 192 pixels.

The AVDP also supports interaction with an external video source. When operated in the external-video mode, the chip allows computer-generated alphanumeric and graphics information to be overlaid on conventional video images. This capability makes possible enhancements to conventional video displays by allowing quick and easy updates to the displayed program—a big advantage when it comes to updating an educational tape or disk that might otherwise need refilming.

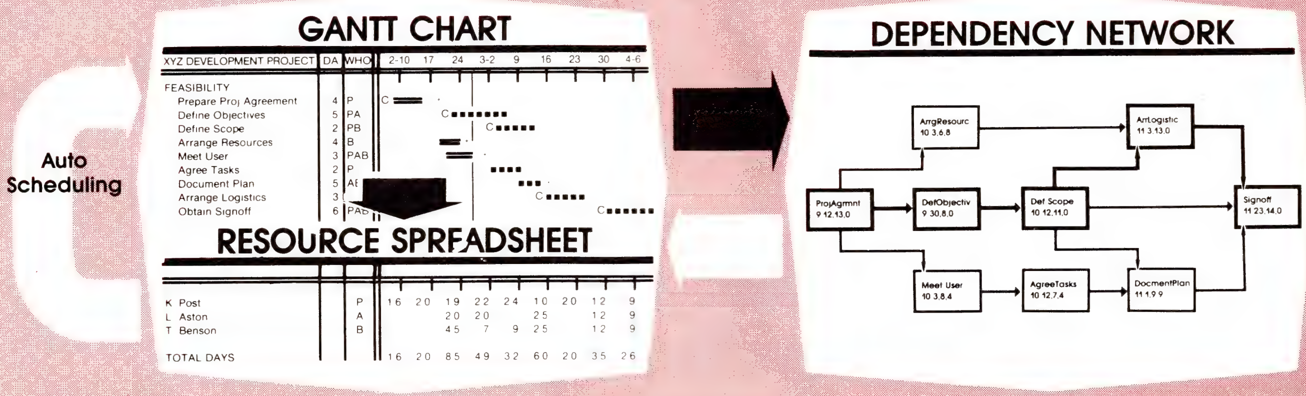
The CPU-to-AVDP interface occurs over an 8-bit bidirectional data bus controlled by three lines from the CPU and a programmable interrupt line. As a result, the CPU can perform a variety of operations, such as writing to and reading from the video RAM, writing to and reading from the AVDP's internal registers, and writing to an internal sound generator included in the AVDP.

The system described contains some external circuitry, such as the device-select block. However, the AVDP goes a long way toward incorporating all the functions needed to generate the video, control, and synchronization signals for TV receivers in low-cost video systems.☐

*The authors are with Texas Instruments Inc., in Houston.*

# PROJECT MANAGER WORKBENCH™

## Project Management for Engineers



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|---|---|---|---|---|---|---|---|---|---|---|---|
| FEASIBILITY | | | | | | | | | | | |
| Prepare Proj Agreement | 4 | P | C | | | | | | | | |
| Define Objectives | 5 | PA | | | C | | | | | | |
| Define Scope | 2 | PB | | | | C | | | | | |
| Arrange Resources | 4 | B | | | | | | | | | |
| Meet User | 3 | PAB | | | | | | | | | |
| Agree Tasks | 2 | P | | | | | | | | | |
| Document Plan | 5 | A | | | | | | | | | |
| Arrange Logistics | 3 | [illegible] | | | | | | C | | | |
| Obtain Signoff | 6 | PAB | | | | | | | | C | |

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|---|---|---|---|---|---|---|---|---|---|---|
| K Post | P | 16 | 20 | 19 | 22 | 24 | 10 | 20 | 12 | 9 |
| L Aston | A | | | 20 | 20 | | 25 | | 12 | 9 |
| T Benson | B | | | 45 | 7 | 9 | 25 | | 12 | 9 |
| TOTAL DAYS | | 16 | 20 | 85 | 49 | 32 | 60 | 20 | 35 | 26 |

### Can you name another project management system which:

- Lets you quickly create a project schedule then interactively reconfigure it
- Lets you set up dependency relationships visually
- Allows resources to be assigned to multiple activities and multiple projects, highlighting any potential overscheduling
- Provides a self-teaching 'menu' mode for the new user and a powerful 'expert' mode for the experienced project engineer
- Automatically prepares a project schedule which meets dependency and resource constraints
- Summarizes variable and fixed project costs at all levels
- Encourages the use of project 'templates' in creating and modifying plans
- Uses the full power of the IBM® PC and compatibles

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- Windowing
- Help menus
- Online tutorial
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Circle 79 on reader service card

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# IBM PC AT HOSTS LOW-COST DESIGN STATION

Users get their choice of either an IBM PC AT-based Dash schematic designer or an enhanced version of the IBM PC- or XT-based Dash-1 and Dash-2

☐ *by Steve Zollo*

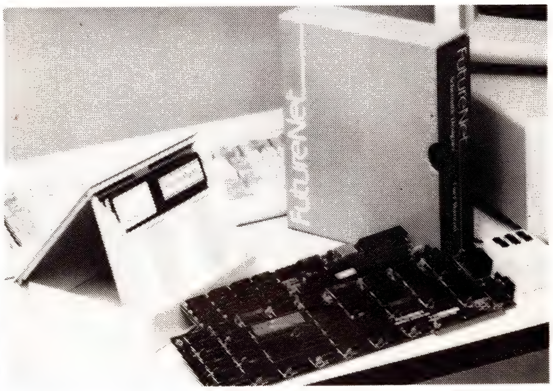
Just a few weeks after its announcement, the IBM Personal Computer AT is again the subject of attention, as FutureNet Corp. is promising to begin delivery next month of AT-based versions of its Dash schematic designer. In addition, the firm has recently unveiled a more powerful version of its Dash-1, which is based on the IBM PC and XT: the Dash-2.

The PC AT version, called the Dash/AT99, is based on the new AT computer with 512-K bytes of random-access memory, 1.2-megabyte and 360-K-byte floppy disk drives, and a 20-megabyte Winchester disk drive. The Dash/AT99 is available in both the Dash-1 and Dash-2 configurations.

The PC- and XT-based Dash-2, which is currently available, has been outfitted with a new coordinated set of enhanced mouse-driven features for editing, plus on-screen help and a more sophisticated parts library scheme. The Dash/AT99 is provided as a complete turnkey design system, and includes the computer, a proprietary graphics controller board, software, mouse, printer, and Strides, a hierarchical design package that extends the design capability of the system to gate-array and very-large-scale integrated-circuit design. The Dash/AT99 is also available as an add-on package in the Dash-1 and Dash-2 versions.

"We couldn't have been more delighted by the IBM announcement of the AT," remarks Terry Zimmerman, vice president of marketing for FutureNet, a producer of electronic design work stations and an IBM value-added dealer. "We knew 10 minutes after the announcement exactly what we wanted to do with it," he says. Zimmerman adds that FutureNet, which to date has delivered approximately 1,500 of its schematic design systems worldwide, placed production-quantity orders for the PC AT just a couple of days after it was announced.

The Intel 80286-based PC AT has an internal memory that can be expanded to over 3 megabytes as well as 41.2 megabytes of disk storage with eight expansion slots. "With the addition of the FutureNet Dash capability, the IBM AT is ideal in the engineering environment for schematic design and as a universal front end to



larger computer-aided design systems," Zimmerman emphasizes. The Dash-1/AT99 is priced at $15,380, while the Dash-2/AT99 version goes for $15,980. The add-on packages sell for $5,380 and $6,280, respectively, for the Dash-1 and Dash-2 models.

Claimed to be faster than the Dash-1, the PC- and XT-based Dash-2 has additional features that simplify design of schematics. Dash-2 files are compatible with Dash-1 drawing files. Dash-2's capabilities, which are available on the Dash/AT99 versions as well, include a tag-and-drag feature with which the user can pick a symbol and drag the targeted selection across the screen while maintaining already established connections, an area-definition feature that uses the mouse to locate any two opposite corners of a desired area, and a window-save feature that allows the user to mark up to four window displays that he can recall at a later time by a single keystroke.

The new Dash-2 also includes a function called Strides, a structured schematic editor with which the user can create a relational data base of schematics, pen lists, net lists, and parts lists covering an entire design project. Effects of changes to one document in the document tree are incorporated into the overall design automatically.

The Dash-2 add-on package for the IBM PC sells for $5,980 with the complete Dash-2 system, including the PC along with a printer, selling for $9,980. Dash-2 for the IBM PC XT is priced at $6,280 for the add-on package and $12,980 for the complete system. Upgrade packages to provide Dash-2 capabilities on existing Dash-1 Edit and Strides systems are available and sell for $250 each.

FutureNet Corp., 6709 Independence Ave., Canoga Park, Calif. 91304. Phone (818) 700-0691
[Circle reader service number 338]

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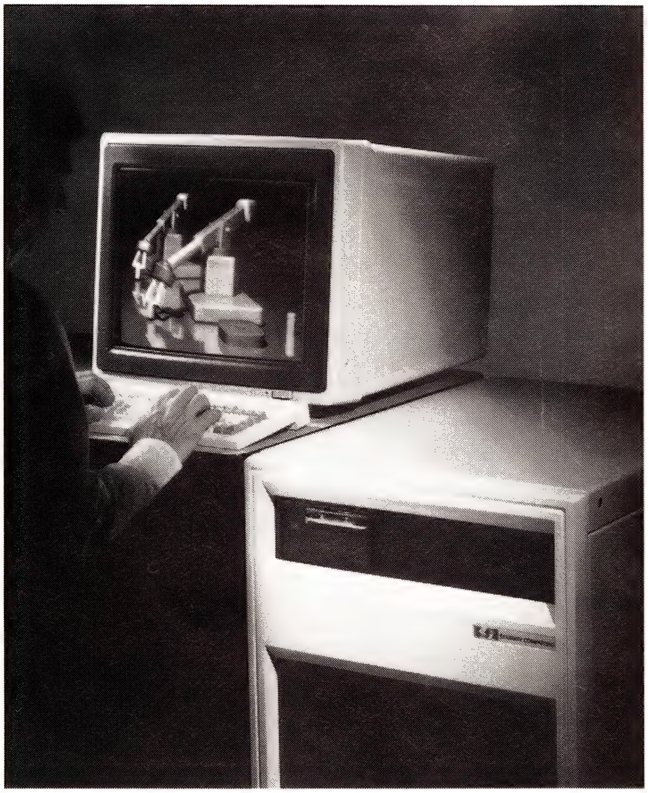
## 32-bit work station sustains 2 MIPS

**Believing that currently** available engineering work stations provide an attractive price-performance ratio and a low entry price but are limited in performance, a one-year-old start-up, Celerity Computing, has assembled a work station using its proprietary 32-bit computer and industry standards such as Unix, Multibus, and Ethernet. The C1200, which can be configured with up to 24 megabytes of physical memory, executes 2 million single-precision and 1.5 million double-precision Whetstone instructions/s.

The work station performs at 1.5 to 2 times the speed of the VAX 11/780 for engineering workloads, at less than one third the cost, according to the company. The model C1200 is not a personal computer appearing as an

TWA.OUR 3 PAIR BEATS THEIR



engineering work station, but a fully capable 32-bit minicomputer that is configured to solve the computational problems of the professional engineer, the company says.

The system architecture allows for flexible configuration of the product to accommodate single- or multiuser systems, either standing alone or networked for access to peripherals and sharing data. The processor architecture, which is partly based on the NCR 32-bit chip set, is optimized for high performance on computationally intensive tasks and supports flexible, high-performance bit-mapped display generation.

Other system features include high-performance, double-precision floating-point arithmetic, a large virtual-address space, and full 32-bit data paths.

The model C1200's operating system is based on an advanced version of Unix, the University of California at Berkeley's 4.2 BSD. The software is optimized for the work-station environment with extensions to support bit-mapped graphics, multiple window displays, distributed files, and enhanced communications.

Compilers available include Fortran, Pascal, and C. Celerity's system is built around a Multibus-compatible bus, which provides the user with a wide choice of peripherals. Accelnet, Celerity's integrated networking product, can communicate with other systems connected in an Ethernet.

The model C1200 is offered with two different color

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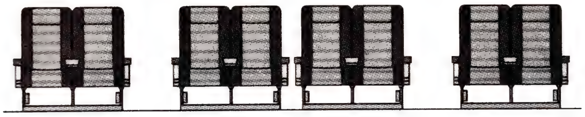

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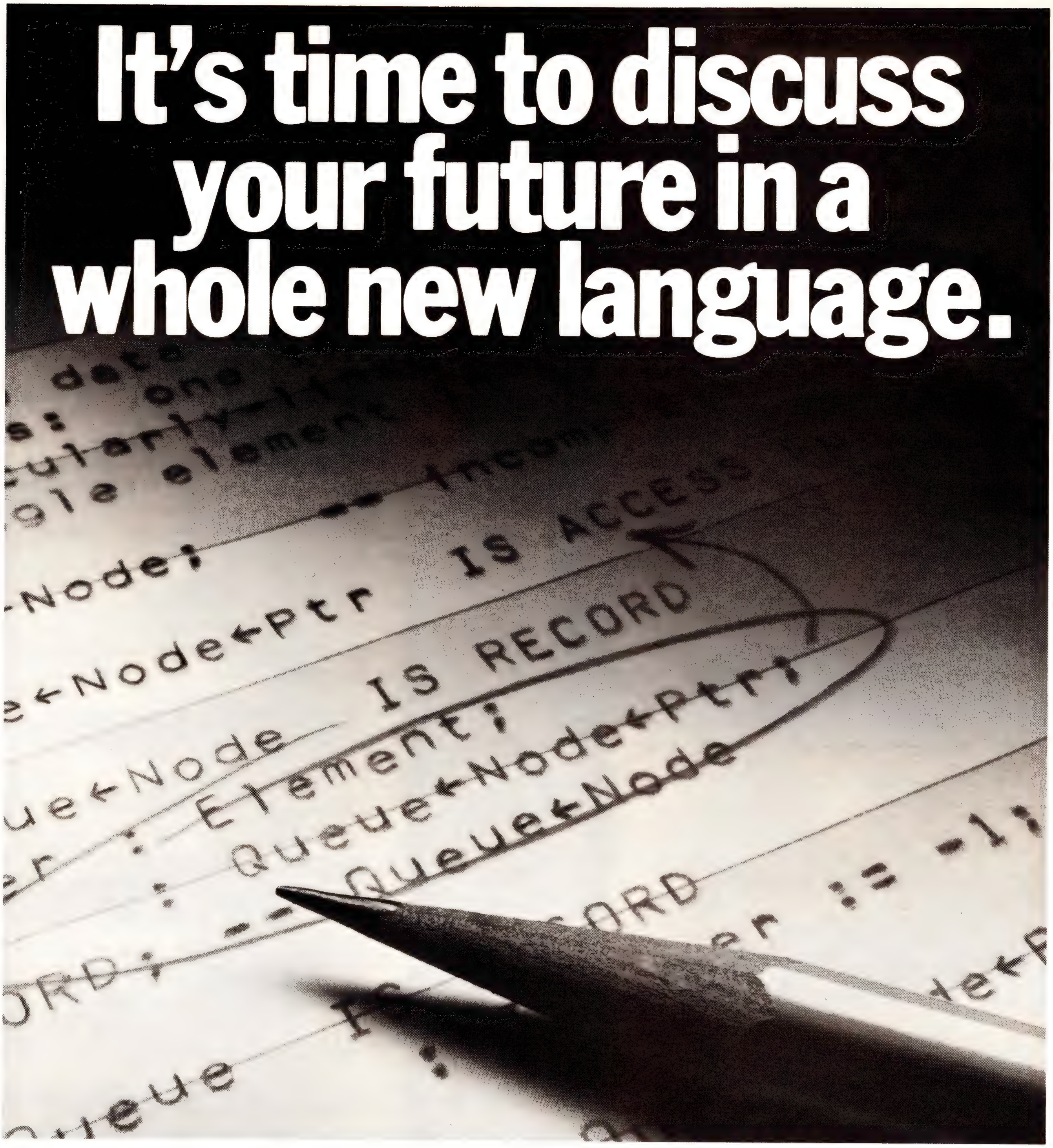

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- Microprocessor Hardware/Firmware Design Engineers
- Fiber Optics Systems Design Engineers
- VLSI and VHSIC CAD/Software Development Engineers
- Analog Circuit Design
- Program Parts Engineers
- Parts Engineering Specialists
- Radiation Effects Analysis
- Worst Case Analysis
- VLSI Design Engineers
- Parts Test Engineers
- Computer Aided Circuit Design
- Electrical/Electronic Engineers
- Power Conditioning Circuit Design Leads
- Solar Array Designers—Spacecraft Power
- Power Systems Engineers
- Analog Circuit Design and Analysis Engineers
- Electrical Distribution Designers
- Artificial Intelligence Specialists
- Robotics Engineers
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graphics display subsystems, both of which are available with table or mouse. The high-resolution display stations use a 19-in. 60-Hz noninterlaced refreshed monitor. This unit provides a resolution of 1,280 by 1,024 pixels, eight bit planes for color selection, and writing speeds of 60,000 1-cm vectors/s. A medium-resolution display using a 14-in. 60-Hz noninterlaced refreshed monitor is also available.

The C1200's basic configuration includes the 32-bit Accel processor, the extended floating-point processor, 2 megabytes of error-checking and -correcting memory, and a software license. In quantity, the system sells for $45,000. The color display station sells for $27,600. Initial shipments are scheduled for November.

Celerity Computing, 9692 Via Excelencia, San Diego, Calif. 92126. Phone (619) 271-9940 [Circle 373]

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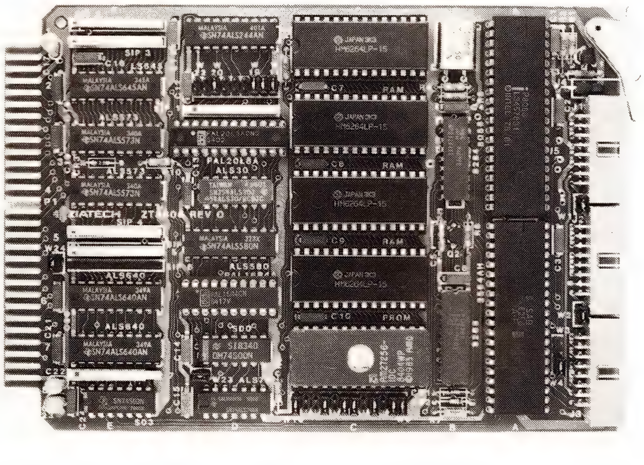
## Single-board 8088 targets automation applications

**A multifunction single-board** computer, the model ZT 8806, combines an 8088 microprocessor, memory, and input/output functions on one standard bus board. It is aimed primarily at dedicated machine and instrument intelligence applications. The manufacturer intends the ZT 8806 for automatic applications requiring 16-bit computation power or memory-addressing capabilities exceeding 64-K bytes.

The ZT 8806 features a 5-MHz 8088 central processing unit that operates in MAX mode. In MAX, for math-intensive applications, it is possible to add the 8087 Numeric Data Processor using Intel's iSBC 337 piggyback processor option. Five 28-pin byte-wide Jedec memory sockets provide space for up to 64-K bytes of programmable read-only memory and 32-K bytes of static random-access memory. Larger amounts of programmable ROM can be added at the expense of RAM space.

Available now, the ZT 8806 includes one serial port, five counter/timers, two 8-bit parallel I/O ports, and an interrupt controller. Priced at $465, it is supported by the same firm's series 8800 prototype development system running on IBM-PC compatible systems.

Ziatech Corp., 3433 Roberto Ct., San Luis Obispo, Calif. 93401. Phone (805) 541-0488 [Circle 340]



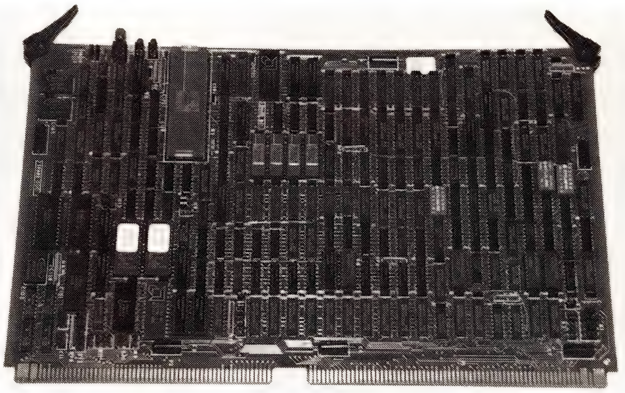
## High-speed processors give fast read-hit rate

**Two processor modules,** the 68010-based model PT-VME100 VMEbus module and the 68000-based model PT-VBS100 Versabus module, execute memory-resident programs with 75% zero-wait-state and 80% half-wait-state read-hit rates, respectively, says their maker.

The 68000 Versabus module has a 16-bit microprocessing unit with a 12.5-MHz clock rate, a 2-K-byte cache memory, and up to 64-K bytes of read-only memory, programmable ROM, or erasable PROM, in addition to a programmable timeout function. The 68010 VMEbus module offers a 32-bit data interface, a 16-bit microprocessor with 10-MHz clock rate, a 4-K-byte cache memory, four 28-pin sockets for local memory requirements, and a timeout monitor with a software watchdog option.

In small quantities, either processor module sells for $3,200 each, with delivery taking three to four weeks.

Performance Technologies Inc., 300 Main St., East Rochester, N.Y. 14445. Phone (716) 586-6727 [Circle 341]



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## Bar-code decoder IC reads four types of codes

**Four major bar-code-system** decoding capabilities are offered by the BR-01 complementary-MOS single-chip large-scale integrated decoder: UPC, EAN, and JAN (standard and short form); Codabar, 3 to 38 characters, including start/stop characters; Code 39, 2 to 38 characters, including start-stop characters with or without check-digit calculation; and 2-of-5 Interleaved/Standard, 1 to 38 characters, with or without check-digit calculation.

The model BR-01 is an 8-bit microprocessor unit offered in either a dual in-line or a flat package. Other features include an asynchronous serial port for data/-command communication, buzzer port for local beep, and light-pulsating-control facility.

The software commands include code selection, check-digit-calculation mode, start/stop-character elimination, read-error transmission, and buzzer remote beep. The model BR-01 runs on a single 5-V power supply and has a selectable baud rate of 9,600, 1,200, 300, or any other rate using an external clock. Delivery takes two weeks; the price is $98.

Opticon Inc., 36 Ramland Rd., Orangeburg, N.Y. 10962.
Phone (914) 365-0090 [Circle 342]

## Typesetting preview software is based on AT&T's Unix

**A computer-based** path to fully specified text, called "/usr/tools," is a Unix-based typesetting preview program and an enhanced version of AT&T's Documentor's Workbench for microcomputers.

The package includes a graphics driver, which allows text files formatted by Unix troff or nroff commands to be proofed at the same site where they are produced. The driver sends the formatted file to a dot-matrix printer in a format comparable to that used during typesetting or volume laser printing.

"/Usr/tools" is available in both Coherent and Xenix versions for the IBM Corp. Personal Computer, PC XT, and IBM compatibles. In addition, it supports technical-document production in Unix-based engineering environments.

The manufacturer claims that by allowing on-site corrections, "/usr-/tools" eliminates extra iterations during typesetting. Once files have been previewed and corrected in the Unix environment, they can be transmitted to the manufacturer's typesetting service through a modem or on disk or tape.

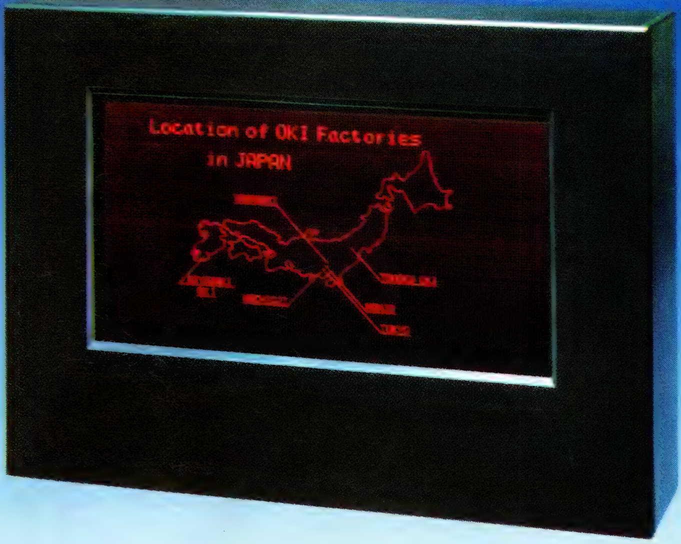
Priced at $995, "/usr/tools" is available now.

Accucom Data Network Inc., 9730 Cascade Blvd., Suite 220, Tigard, Ore. 97223.
Phone (800) 684-2850 [Circle 344]

## Source-level debugger runs in real time

**A programmer can now** trace and display real-time program execution at the program source-code level by using two source-level debuggers, called the Source Probe and the Software Source Probe. These combine source-level debugging with in-circuit emulation.

The Source Probe consists of a board that plugs into the personal computer and contains an umbilical



OKI Announces a New Era in Plasma Graphics

The OKI SS Series of plasma displays offers a new way of communicating complex ideas for industry and the consumer. The flat displays provide a compact alternative to bulky CRTs in personal computers. Fine resolution and elimination of flicker and glare reduce operator eye-strain and fatigue.

Other applications include point of sale and banking terminals, measuring instruments and numerical control machines.

- **SS640400R** (W 640 dots × H 400 dots: Neon orange) (Under development)
- **SS480240R** (W 480 dots × H 240 dots: Neon orange)
- **SS320160R** (W 320 dots × H 160 dots: Neon orange)
- **SS256128R** (W 256 dots × H 128 dots: Neon orange)
- **SS192020R** (W 192 dots × H 20 dots: Neon orange)
- **SS096016R** (W 96 dots × H 16 dots: Neon orange)

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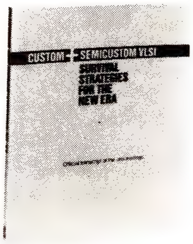


cable that plugs into the computer's 8088-based central processing unit socket. The Software Source Probe is the unbundled software from the Source Probe. It is said to provide all the same source-level debugging features except those requiring the hardware.

Both debuggers are compatible with Lattice C, Microsoft C, and Microsoft Pascal. The Source Probe has an on-line text editor and can display and edit up to 10 source files at the same time. In addition, it provides such hardware-assisted debugging features as breakpoints on reading or writing to memory locations and protected memory.

Both tools are available immediately from stock. The Source Probe sells for $3,190 and the Software Source Probe for $975.

Atron Corp., 20665 Fourth St., Saratoga, Calif. 95070.
Phone (408) 741-5900 [Circle 343]

## Ac circuit analysis eased by optimizing program

**An updated version** of Comtran, a set of programs that simulates and optimizes analog circuits, runs on Hewlett-Packard Co. 9836, 9816, 9920, 9845, and 9020 computers. The manufacturer claims that this version is more than 50 times faster than the HP AC-CAP program.

Comtran may be used for simulating and optimizing both active and passive circuits with up to 98 nodes. It calculates all frequency and time-domain transfer function and impedance results, including group delay and relative phase delay.

The program also calculates an output waveform given any circuit and any input waveform. With Comtran, the user can study circuit behavior without building a prototype, combine measurements with circuit models, and synthesize active filter circuits. The program is described as user friendly.

Full-program demonstration versions are available of these copy-protected programs. The one-time fee and licensing use prices are: AC-CAT, $750; S-Wave, $750; and Plot ST, $750. For the HP 9020 computer, each program is $1,500.

Jensen Transformers, 10735 Burbank Blvd., North Hollywood, Calif. 91601.
Phone (213) 876-0059 [Circle 345]

## Software links 8-, 16-bit development systems

**An interface between** Intel iRMX 86 systems and the NDS-II Network Development System, the iRMX-NDS-II Link, uses a high-speed Ethernet coaxial cable to link individual iRMX systems 86/310, 86/330A, or 86/380 with mass storage, line printers, and archives. The iRMX is a flexible system of off-the-shelf components. The NDS-II—a multiuser microprocessor development system—links 8- and 16-bit Intel development systems in a unified engineering environment.

By connecting the two systems, the iRMX-NDS-II link provides a networked environment, including database and resource sharing, hierarchical file structures, and remote job execution. The maker says direct telephone assistance is available from its support engineers.

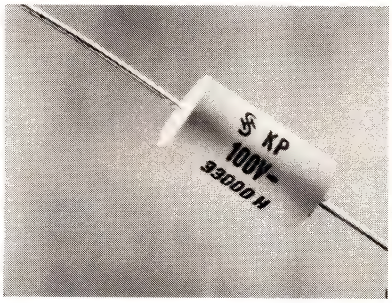
The iRMX-NDS-II Link is available now. The software license is $2,500 for eight copies, and the Ethernet controller handset costs $2,000.

Intel Corp., Literature Dept. I-12, 3065 Bowers Ave., Santa Clara, Calif. 95051.
Phone (408) 496-9484 [Circle 346]

## Encapsulated capacitors are rated up to 2,200 pF

**Epoxy-resin encapsulated** to resist humidity and chemical effects, the model B33074 flame-retardant polypropylene capacitor has a rated voltage of 100 V dc and a temperature range of –40° to +85°C. The axial-leaded device offers a rated capacitance of 2,200 pF, high stability, and a negative temperature coefficient.

The manufacturer says that the capacitor can be used in printed-circuit boards and as a resonant circuit capacitor in radio-, intermediate-, and carrier-frequency filters in telecommunications. Furthermore, the B33074 capacitor's flame-retardant enclosure material carries an Underwriters Laboratories' 94V-O certificate to show compliance with the enclosure requirement of UL-1414.



The model B33074 capacitor typically costs 20¢ each when ordered in quantities of 1,000. Deliveries can be made in 12 to 14 weeks.

Siemens Components Inc., 186 Wood Ave. S., Iselin, N.J. 08830.
Phone (201) 321-4842 [Circle 351]

## COMPONENTS

### Voltage reference modules are stable to ±2 ppm/year

**Voltage reference silicon** diodes and voltage reference modules are now available that guarantee voltage-time stability better than 2 ppm/year and low-frequency noise better than 0.05 ppm root mean square. The PRD7505 PRD7505-LN reference diodes drift no more than 5 ppm/year, while the TCM-III/2 and TCM-IV/2 reference modules stay within 2 ppm/year.

The silicon diode series is a family of selected and aged silicon reference diodes, mounted in a hermetically sealed, oil-filled metal can. The heart of each voltage reference module is a time-stable reference diode. Module circuitry buffers the reference diode from all unwanted external input voltage changes and output load changes.

The PRD7505-LN diode and TCM-III/2 module have an internally generated noise of no greater than 0.08 ppm. The TCM-IV/2 module boasts a noise figure, defined as the maximum residuals of 6-min averages over 24 hours, that does not exceed 0.05 ppm.

Available in 10 weeks, the diodes sell for $1,084 and $1,470 and the modules sell for $1,400 and $2,800.

Standard Reference Labs Inc., P.O. Box 388, Coan Place, Metuchen, N.J. 08840. Phone (201) 549-9280 [Circle 352]

### Binary-coded switch measures just 0.19-in high

**A fully sealed** subminiature switch, the 3300 Series Micro-Dip, is a low-profile binary-coded switch measuring 0.38 in.$^2$ by 0.19 in. high. Permanent sealing is accomplished by an integral O-ring and epoxy-sealed terminals. The sealed switch has withstood the Fluorinert leak test for board-mounted components and is designed to perform in harsh environments.

The 3300 series comes in top- as well as side-adjustable models with either a flush or an extended actuator shaft. With single-pole binary-coded decimal or complement codes, the 10- or 16-position (hexadecimal) switches suit digital-logic applica-

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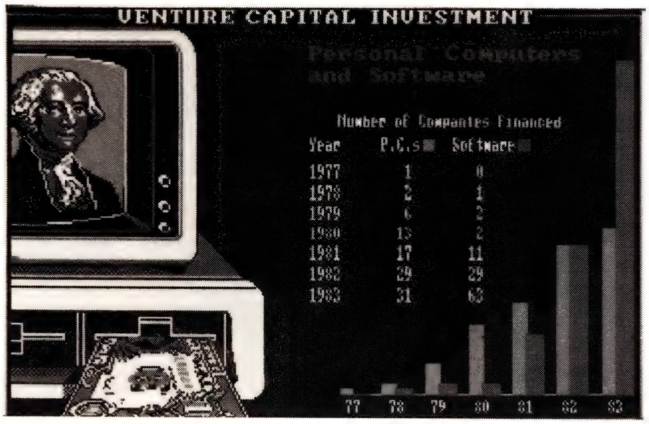
tions. The average unit price for nominal quantities is $2, for volume orders about $1. Shipment is six weeks after receipt of order.

EECO Inc.,1601 E. Chestnut Ave., P.O. Box 659, Santa Ana, Calif. 92702.
Phone (714) 835-6000 [Circle 372]

## With interface, printers copy a screen's content exactly

**An interface between color** printers and applications programs running under MS-DOS or PC-DOS enables the printers to reproduce exactly what appears on the screen. Called EV Capture Plus, the interface also enables the user to transfer graphics, images, and text from a wide spectrum of application programs to the firm's ExecuVision environment, where they can be enhanced and structured as presentations.



Number of Companies Financed

| Year | P.C.s | Software |
|---|---|---|
| 1977 | 1 | 0 |
| 1978 | 2 | 1 |
| 1979 | 6 | 2 |
| 1980 | 13 | 2 |
| 1981 | 17 | 11 |
| 1982 | 29 | 29 |
| 1983 | 31 | 63 |

Capture can be performed at almost any stage during the operation of a program. For example, a user who has developed a bar graph in a graphics program can interrupt the program and capture the image to be printed out in color. It is possible to print the screen immediately, or to store the currently displayed information on a disk in ExecuVision format.

EV Capture drives industry-standard color plotters and printers, including the IBM Corp. color printer, IDS Prism, Hewlett-Packard Co. plotter, Quadram Quadjet, Epson FX-80 and MX-80/100, and Xerox Diablo Inkjet. The program, which runs under DOS 1.1, 2.0, and 2.1 and consumes 34-K bytes of memory, is priced at $125.

Visual Communications Network Inc., 238 Main St., Cambridge, Mass. 02142.
Phone (617) 497-4000 [Circle 353]

## Software converts PC files into Wang WPS format

**Designed to help users** of the MultiMate Professional Word Processor to exchange files between their personal computer and dedicated word-processing minicomputers, the MultiMate Exchange software was written to make IBM Corp. Personal Computers emulate the Wang word processor. The program will convert Wang's WPS format files to MultiMate DOC format and vice versa.

The conversion process maintains almost 100% document integrity; no clean-up editing will be needed in most cases. Unlike conversion to ASCII files, exchange WPS conversion retains text-formatting information from the original document: format lines, centering, and tabs are maintained and no extra return characters are added to the converted file.

Transfer of files between machines will require a device called the FormScan Codem intelligent interface. Most PCs are set up to talk to other systems asynchronously, but the Wang communicates internal documents by binary synchronous transmission only. The FormScan Codem converts between these communications modes with error checking. It also takes into account Wang's modifications to the 2780 bisynchronous protocol.

The price of the bundled unit (MultiMate Exchange and FormScan Codem) is $7,500 plus $300 for installation. Delivery time is 30 to 45 days.

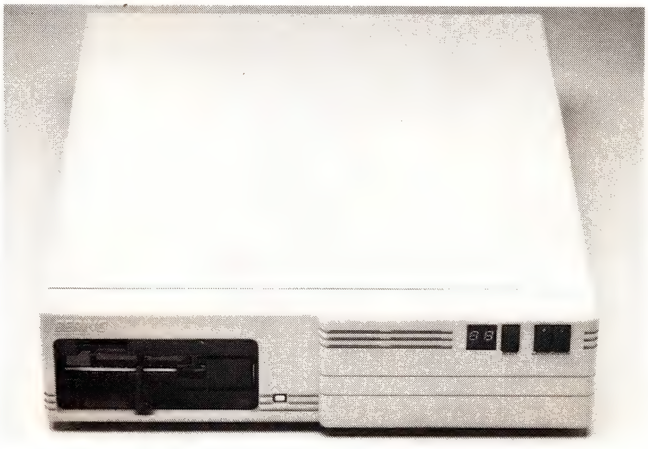
MultiMate International Corp., 52 Oakland Ave. N., East Hartford, Conn. 06108.
Phone (203) 522-2116 [Circle 363]

## Tape drive backs up HP computer systems

**Intended for** Hewlett-Packard Co.'s personal and technical computers, a ¼-in. tape drive subsystem has a formatted capacity of 20 megabytes. Designated the model T100, the subsystem can back up an entire hard disk without using a host computer and will run like a hard disk with full random-access capability. A 64-K-byte cache memory is included to improve the performance of random read/write operations.

The model T100, with a full streaming rate of 25 s/megabyte, will back up HP's or the company's hard disks with capacities below 100 megabytes. The equipment may be used with non-HP computers with IEEE-488 or HP-IB interfaces if special drivers are installed. The model T100 is activated by push buttons and does not require an extra software driver. In addition, the computer is not interrupted.

Currently, the subsystem supports four types of HP disk emulations: a 15-megabyte volume, as in the



HP9134XV; a 10-megabyte volume, as in the HP9134B; a 5-megabyte volume, as in the HP9133V; and 4 volumes of 1.2 megabytes, as in the HP9134A.

The subsystem has three push-button switches on the front panel to handle user commands; a light-emitting-diode display guides the user, indicates system status, and identifies failed components.

The model T100 sells for $2,380 each; deliveries take 30 days.

Bering industries Inc., 1400 Fulton Pl., Fremont, Calif. 94539.
Phone (415) 651-3300 [Circle 357]

## Modem has 14,400-baud/s data-transfer speeds

The Omnimode 14.4 modem has data-transfer speeds that reach 14,400 baud. Front-panel control over one modem or an entire network of modems eliminates the need to physically strap them at remote locations. A remote-modem-control option allows central site control of remote-modem speed, port configuration, strapping, transmission level, and modulation without remote operators or technicians.

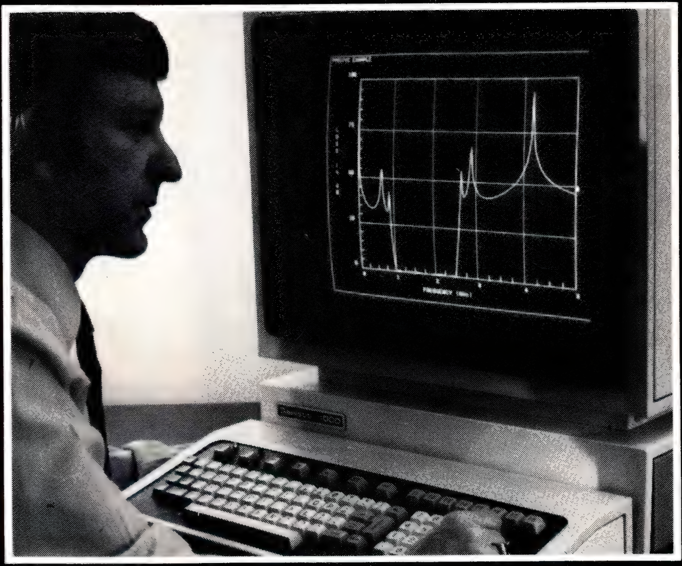
Diagnostic capabilities include standard modem and line tests plus CCITT V.54 loop tests. The 14.4 also incorporates hardware and firmware to provide on-line performance over C2-conditioned lines.

The modem is available now in both stand-alone and high-density central-site models. The central-site model can be mixed in the CS nest with up to 16 modems in 15¾ in. of rack space. It is priced at $10,000.

Racal-Milgo Inc., 8600 N.W. 41st St., Miami, Fla. 33166.
Phone (305) 592-8600 [Circle 358]

## Power conditioner blocks surges, power distortion

**Providing protection** against power-line noise disturbances that can cause computers to malfunction, the Peak-Current Line 2 power conditioners correct electrical problems by means of the PowerLogic control, which features an internal microcomputer for voltage regulation. Output voltage is kept within −8% and +4% of



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nominal voltage for input-line voltage variations of 90 V to 138 V ac, the manufacturer states.

The Peak-Current Line 2 has low forward-transfer impedance and is designed to provide undistorted power to high-crest-factor loads such as the types of switching power supplies found in most computer systems, the company claims.

The following models are available in the given power ratings and delivery schedules: model 70301, 500 VA, $470, two weeks; model 70303, 1000 VA, $595, six weeks; model 70306, 2000 VA, $1010, from stock immediately.

Topaz Electronics, 9192 Topaz Way, San Diego, Calif. 92123.
Phone (619) 279-0831 [Circle 348]

## 50- and 65-W switchers break power-price barrier

**Triple- and** quadruple-output 50- and 65-W switch-mode power supplies for microcomputers and peripherals, process-control systems and automatic test equipment are now being offered at the unusually low price of $0.60/W in quantities of 10,000 and up.

The 10 models in the CF series are based on a minimized-parts-count flyback architecture and achieve a verified minimum mean time between failures of 100,000 h, the manufacturer states. The series has an operating efficiency of 75% (typical) over the entire input range, maintaining cool operation despite input-voltage variations.

Over the –20°-to-+70°C operating temperature range, the +5-V output has a stability of 0.05%°C (typical), while all other outputs have a stability of 0.1%°C (typical).

In lots of 100, triple-output models sell for $44.30 for 50-W versions and $58 for 65-W units. Quadruple-output models sell for $48.20 for 50-W versions and $62.60 for 65-W units. Delivery takes three to five weeks after receipt of order, and quantity orders can be filled.

Semiconductor Circuits Inc., 49 Range Rd., Windham, N.H. 03087.
Phone (603) 893-2330 [Circle 347]

## Monochrome monitor has 2,000-character resolution

**Designated the model** SG-1000, a cathode-ray-tube monitor has a phosphor green display and a dark faceplate over its screen to cut glare. The 12-in. screen offers a resolution of 2,000 characters. The 16.5-lb. monochrome monitor is compatible with many popular personal computers, such as the Apple II, Atari 800, Commodore 64, IBM PC, and the NEC PC.

The SG-1000 has scanning frequency, video circuit, and power input capabilities usually found in more expensive models, according to the company.

Selling for a price of $129, the SG-1000 monochrome monitor is available now.

Sakata USA Corp., 651 Bonnie La., Elk Grove Village, Ill. 60007.
Phone (800) 323-6647 [Circle 366]

## Data acquisition system suits Macintosh computers

**A data acquisition** system dubbed Macquisition is based on the Apple Computer Inc. Macintosh computer and the Taurus One/O5 data acquisition front-end from Taurus Computer Products Inc. The hardware includes a Macintosh with an Imagewriter printer, 16 12-bit analog input channels, 16 digital input/output points, and a termination panel for easy field wiring.

The system runs on Microsoft Basic and Multiplan software as well as the company's Macquisition software. The Macquisition package lets users set up a data acquisition application by using a spreadsheet template. It then automatically collects the data and stores it in another template that can be reduced for reports and charts.

Including installation and on-site training, the price for the package is $6,600. It is also available on a three-year lease basis at $240 per month.

Small Business Computers of New England Inc., P.O. Box 397, Amherst, N.H. 03031.
Phone (603) 673-0228 [Circle 354]

## Unit works unattended in cold climates

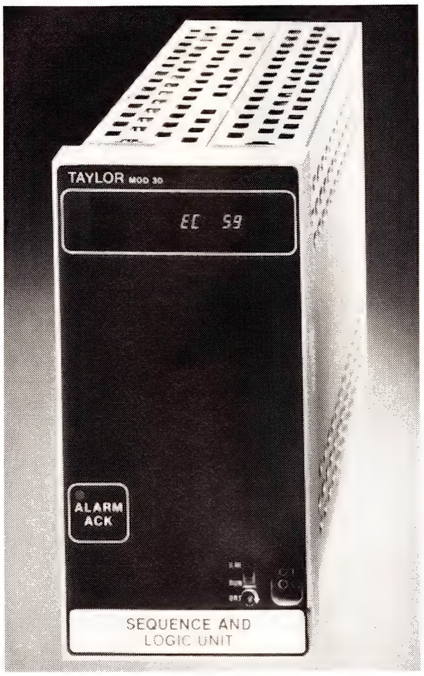
**Designed for remote,** unattended operation in arctic-type and other harsh environments for extended periods of time, a data acquisition and telemetry system, the Arcdats-1, has the capacity for 75 input channels from most types of active and passive transducers. Each channel has an input instrumentation amplifier, a user-selected gain setting, and its own voltage excitation level to the transducer.

Arcdats-1 accommodates up to five 15-channel input modules with either 8- or 12-bit resolution. Input channel polling is performed at selectable intervals, settable anywhere from scans/s to scans/month. It will store up to 2.2 megabits of data and can be used in a master/slave arrangement for data acquisition from several remote units.

The system comes with a serial RS-232-C asynchronous data port for connection to a computer or modem for real-time data reduction and analysis. Power is supplied by long-life battery packs.

Available in four weeks after receipt of order, a standard master system sells for $7,999. A 15-megabit optional memory is also available.

Arctec Systems, 9104 Red Branch Rd., Columbia, Md. 21045.
Phone (301) 730-1237 [Circle 355]



## Process controller integrates sequential control functions

**A microprocessor-based** instrument that integrates sequential control functions into the MOD 30 control group, the MOD 30 Sequence and Logic Unit configures both automatic start-up and shut-down as well as an interlocking and a batch-control scheme. It performs conditional logic and controls sequential and nonsequential on/off states of outputs in increments of 0.25 s to 99.9 h. An off-line capability lets the program test and modify control sequences without disturbing the process.

Priced at $1,900 in single-unit quantities, the unit can be delivered in six weeks after ordering.

Taylor Instrument, 95 Ames St., P.O. Box 110, Rochester, N.Y. 14692.
Phone (716) 235-5000 [Circle 367]

## Motion-control system manages up to four axes

**The menu-driven,** programmable model 3000 Indexing System simultaneously controls up to four axes of motion, using one 16-bit 8088 microprocessor-based indexer for each axis. Up to four indexer boards can be used to coordinate complex multiaxis moves, including time delays and conditional operations.

Each axis can connect to limit switches, a joystick, and incremental encoders. The manufacturer claims electronic stepping accuracy of ±0 steps of commanded distance, velocity repeatability of ±0.02%, and a

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velocity range of 0.017 steps/s to 1,092,000 steps/s. Priced at $3,800 for a unit controlling one axis, the model 3000 is available from stock.

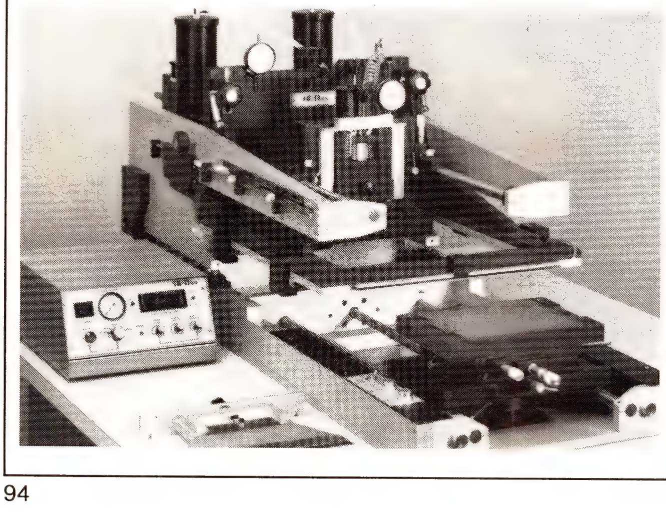
Compumotor Corp., 1179 N. McDowell Blvd., Petaluma, Calif. 94652. Phone (707) 778-1244 [Circle 368]

## Screen printer helps make deposition more precise

**A semiautomatic** screen printer for thick-film or solder-paste deposition permits a repeatable registration to within ±0.0005 in. The model SP-1500's substrate-holder carriage travels on ¾-in. hardened rods, and a drive cylinder with a built-in adjustable cushion on both ends positions the carriage rapidly and prevents it from slamming against hardened stops. Also, the printer uses only solid-state controls for its automatic print cycle.

The machine is suitable for both prototype and high-volume production. One switch executes all modes, either single-print with flood return, print-flood, flood-print, alternate, and/or double, and contact or off-contact. A three-point screen-frame registration permits easy screen change, and the model SP-1500 accepts all standard frames up to 15 by 15 in., 17 by 12 in., or smaller.

The spring-adjusted squeegee head also travels along the ¾-in. hardened rods in an up-and-down motion to assure precise squeegee-to-substrate alignment over the entire print stroke. The print stroke is adjustable from 1 to 14 in., with print speeds from 0 to 15 in./s. The unit requires 115 V, 60 Hz, and 1 A; 50-Hz units are available. It also requires a factory air supply of 80 to 125 lb/in.$^2$ at 6 ft$^3$/min and a vacuum of 25 Hg at 4 ft$^3$/min.



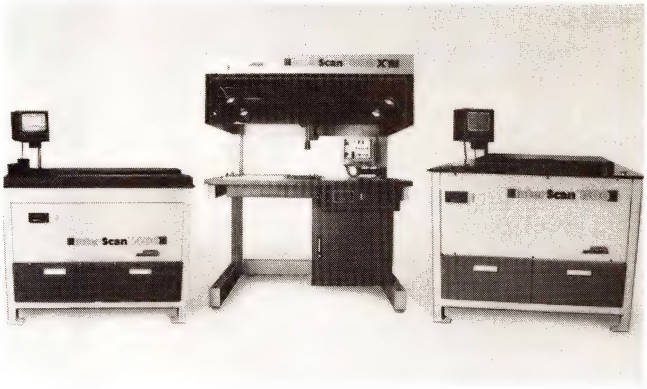
Available within eight weeks, the model SP-1500 is priced at $19,000. Including the unit that supplies the vacuum, the printer sells for $20,000.

MPM Corp., 71 West Street, Medfield, Mass. 02052.
Phone (617) 359-7928 [Circle 362]

## Line of board inspectors makes variety of checks

**One of three** additions to the company's printed-circuit-board automation line, the InterScan 1400 inspects bare boards for the presence and location of holes following punch pressing or computerized-numerical-control drilling operations. The model 1500, a pre-solder system, inspects the bottom side of boards to verify that component leads have penetrated the board and are clinched properly.

The model 1000XT checks the top side of loaded boards for placement and polarity of components including dual in-line packages, diodes, and potted transistors that have markings such as stripes, dots, and notches. Each system uses the firm's model 2000 vision system and high-resolution cameras to process the captured image using 64-level gray scale analysis techniques.



The systems are equipped with a 400-K-byte 3½-in. floppy-disk drive; an optional 10-megabyte hard disk is available. A single-board computer housed in the vision system provides 128-K bytes of random-access memory and 32-K bytes of battery-backed CMOS memory for on-board user data storage. The system has four RS-232-C channels through which to interface with the user's host computer for executing data-base functions. Each system comes in a manual-load, stand-alone work station, or an auto-feed, pass-through model that can be integrated with existing lines for in-line inspection.

The model 1400 sells for $39,900, while the models 1500 and 1000XT are each priced at $47,500. Deliveries can be made within 60 days.

Control Automation Inc., Princeton-Windsor Industrial Park, P.O. Box 2034, Princeton, N.J. 08540.
Phone (609) 799-7743 [Circle 364]

## Robot handler automates transport of substrates

**In a move to eliminate** operator loading and unloading of hybrid substrates from a variety of substrate containers, an automatic handler option for the manufacturer's W419 Passive Trim System is being introduced. The robot handler consists of two modules; an X-Z cartesian positioner arm equipped with a vacuum pick-up hand, and a shuttle arm attached to the W419 system that can move substrates into the system and remove finished ones at the same time.

Linked with the model W419 by a hardware and software interface, the robot handler comes with a teaching pendant. The shuttle arm by itself is also available, for integration with existing furnace-to-trimming system conveyors.

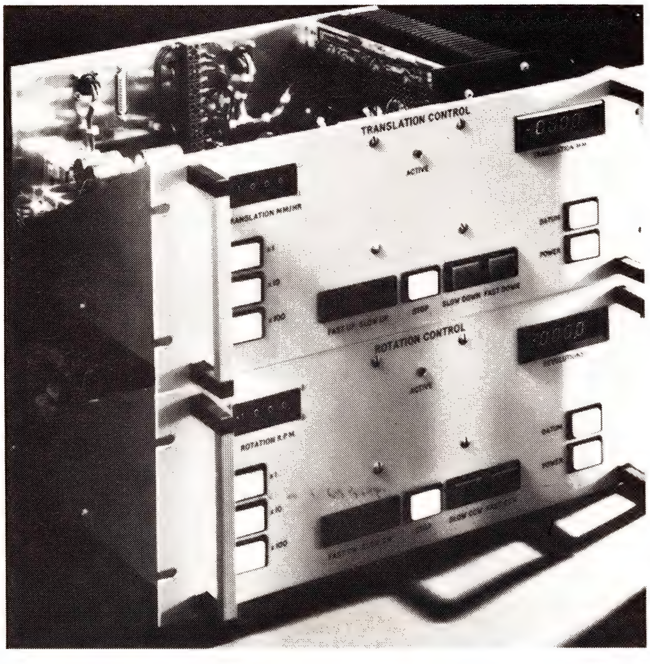
Price for the complete handler (positioner arm and shuttle arm) begins at under $50,000. The shuttle arm is priced at about $20,000. Delivery will begin in the second quarter of 1985.

Teradyne Inc., 183 Essex St., Boston, Mass., 02111. Phone (617) 482-2700 [Circle 374]

## Translation and rotation unit suits crystal growing

**Based on a** quartz crystal oscillator, a system for crystal-growing applications comprises microprocessor-controlled translation and rotation units that provide precise velocity control of high-resolution (10,000 steps/revolution) stepper motors.

The drives also can be fitted with a 20-mA current loop serial interface to operate with many computer control systems, enabling them to perform such complex processes as multiple pass zone refining, accelerated and crucible rotation, and automatic diameter control. Rotation rates in the 0.0001-to-99.99-rpm range can be set digitally on thumbwheel switches, with motor direction controlled by push buttons. The integrated rotational position from preset data is displayed on a digital readout, and additional buttons permit fast rotation in either direction.



The translation and rotation units have identical layouts. The selection switch in the translation unit is calibrated to read from 0.01 to 9,999 mm/hr when the stepper motor is used with a 1.27-mm pitch lead screw.

Priced at $15,400, the system can be delivered within 10 weeks after receipt of order.

British Information Services, 845 Third Ave., New York, N.Y. 10022.
Phone (212) 752-8400 [Circle 365]

## System lets microcomputers function as CAD stations

**A peripheral called** Complete converts personal computers into computer-aided design or engineering work stations. The system carries out input and output functions including plotting, digitizing, and cursor-position control.

In the plotting mode, Complete is a large-format D-size plotter featuring an automatic pen changer and is compatible with Hewlett-Packard Co. systems. In the digitizing mode, a cross-hair sight is projected onto the drawing and positioned to within one thousandth of an in. using an attached proprietary positioning device, designated Fasturtle. In this mode, Complete emulates the Summagraphics protocol, the firm says. In the third mode, the Fasturtle is used for cursor positioning and menu selection.

The system features an open flatbed plotting and digitizing mechanism that may be mounted horizontally or vertically on an office wall. It includes an RS-232-C interface and is software compatible with many other CAD packages.

Available now, Complete sells for $5,995.

Alpha Merics Corp., 20931 Nordhoff St., Chatsworth, Calif. 91311. Phone (213) 709-1155 [Circle 356]

## Satellite TV receiver permits remote control of functions

**A line of home satellite** television receivers includes the SC-7037S, featuring infrared remote control and a built-in antenna-positioner control and power supply. The SC-7037 is a mid-priced model also offering remote-control, while the SC-7037E is a basic unit without these features.

All the receivers offer such features as rapid scan control, signal-strength light-emitting-diode bar graphs, skew control, and audio fine tuning. An intermediate-frequency gain control provides balancing for cable loss if needed, and a switch lets installers replace down-converters for servicing without removing the entire receiver.

Internal bypass circuitry on the models SC-7037S and SC-7037 facilitates automatic switching from satellite to outdoor antennas, cables, or other devices when the receiver is turned off. The two models' hand-held remote

control allows armchair control of basic functions.

Available now, the line's suggested list prices range from $776.55 to $1,235.80.

Winegard Co., 3000 Kirkwood St., Burlington, Iowa. 52601. Phone (319) 753-0121 [Circle 359]

## Filter eliminates signals that harm TV reception

**Intended for use with** receive-only televisions, a filter inserts a high loss into the path of edge-band frequencies in the 60-to-80-MHz band, eliminating some of the spurious signals before they reach the screen.

A six-stage filter, which attenuates the unwanted frequencies, is 50 dB, and the notches can be tuned to allow precise positioning for maximum loss at the interference frequencies. Designed with stable air capacitors and coils, the unit comes in a case measuring 5 by 2 by 2 in., including mounting brackets.

Available from stock, the filter sells for $68.

Alaun Engineering, 2305 Florencita Dr., Montrose, Calif. 91020. Phone (818) 957-0618 [Circle 360]

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## Reed relay occupies small board space

**A microminiature** reed relay, the series SG, occupies 0.16 in.$^2$ of printed-circuit-board space. The manufacturer offers this relay for high-density packaging requirements.

The series SG is available in single-pole single-throw (form 1A) and double-pole single-throw (form 2A) configurations. Options include electrostatic shielding and coaxial electrostatic shielding with terminations at both ends of the relay. The SG series can use any of several standard reed switches and comes with 5- or 12-V coils.

The SG series relay, in the 5-V, form 1A version, is priced at $1.05 in quantities of 1,000. Delivery takes up to seven weeks.

Standex Electronics, 4538 Camberwell Rd., Cincinnati, Ohio 45209. Phone (513) 871-3777 [Circle 369]

## Solid-state relay family comes in varied packages

**Designed to simplify** mounting into standard integrated-circuit pinouts, a family of solid-state relays features discrete design as well as space-saving packaging. The line includes standard and custom packages in both conventional chassis mounts and printed-circuit pinouts. The SSR packaging is industry-standard for IC-style components.

The concepts of in-line pinouts—single in-line package, dual in-line package, and double DIP—will make it easy, the manufacturer claims, for computer-aided design users to include relays in their software. The firm cites greater design flexibility for specialized applications in energy management, programmable controllers, robotics, and industrial process control as applications advantages.

Prices for the standard-design relays range from about $11 to about $25 in prototype quantities, and volume discounts are available. Delivery is four to six weeks after receipt of order.

Electronic Instrument and Specialty Corp., 42 Pleasant St., Stoneham, Mass. 02180.
Phone (617) 438-5300 [Circle 370]

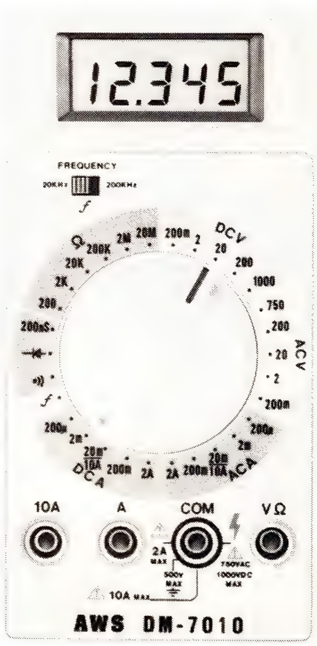
## Handheld multimeter has built-in frequency counter

**A handheld digital** multimeter that features 4½ digits with a maximum display of 19,999, the DM-7010 boasts nine functions on 33 ranges, with a claimed basic dc accuracy within 0.05% of the reading. The DM-7010 also has ac and dc current functions, resistance and conductance capability, diode and continuity tests, and a frequency-counter range up to 200 kHz.

Options offered are an ac current jaw adaptor, high-voltage probe, transistor-diode test adaptor, and carrying case. Dc volt ranges are 200 mV to 1,000 V.

The price of a unit, available immediately from stock, is $170.

A. W. Sperry Instruments Inc., 245 Marcus Blvd., Hauppauge, N.Y. 11788. Phone (516) 231-7050 [Circle 350]



## Impedance bridge measures up to 13 factors

**A new generation of** VideoBridge impedance bridges for users and manufacturers of passive components incorporating cathode ray tube display and microprocessor control, measures up to 13 impedance factors. The test-frequency range of the models 2150 and 2160 is 20 Hz to 150 kHz, with 0.02% basic accuracy claimed by the manufacturer. This test-frequency capability is intended to make them especially attractive to users of components that operate at high frequencies, as in switching power supplies.

The 2160 is a stand-alone version with a built-in cassette drive. IEEE-488 and RS-232-C interfaces can be used for remote programming and communication with peripherals; interfaces for automatic component handlers are available as well.

The 2150 is priced at $5,195 and the 2160 at $6,195. Delivery for either is from six to eight weeks.

Electro Scientific Industries Inc., 13900 N.W. Science Park Dr., Portland, Ore. 97229.
Phone (503) 641-4141 [Circle 349]

## Board tester handles 5,000 linked points in 1.8 s

**Able to test** double-sided, multilayer, or inner-layer boards, the model 101 Continuity Analyzer can evaluate 5,000 connected points in 2,000 networks in 1.8 s at 1,000 V. The model 101's test voltage range is 100 mV to 1,500 V, and resistance measurements are from 0.1 Ω to 100 MΩ. The model 101 employs an MC68000 processor with 512-K of random-access memory, two 5¼-in. floppy disk drives, and a 40-column printer.

The system's menu-driven software includes edit functions on- or off-line, and a self-learn program that permits postproduction changes and accommodates file transfers, which are monitored on a video display terminal. The system is cost-efficient because pins are reusable and neither wiring nor soldering is required. Fixtures are tested on a pneumatically actuated test head with grid access, and test cycling is activated by palm switches.

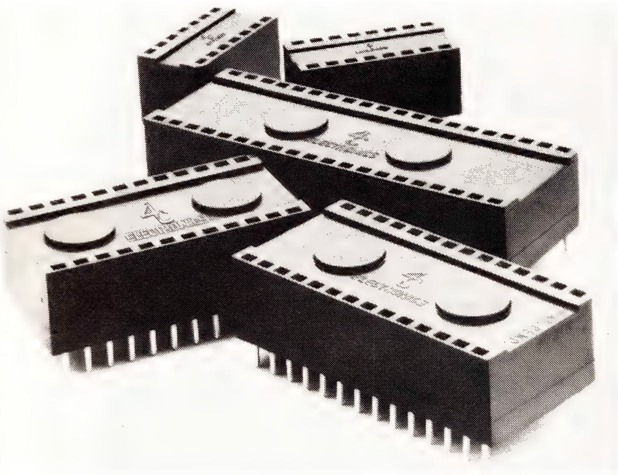
A 20,000-point system at 600-V sells for $200,000 and is available 120 days after receipt of order.

CIS Testronics, 1810 North Glenville Dr., Richardson, Texas 75081.
Phone (214) 238-8378 [Circle 361]

## A 24-pin programmed socket serves as adaptor for ICs

**Thanks to a new 24-pin** programmed socket, integrated circuits having different pinouts can be used with current printed-circuit-board layouts. To establish pinout compatibility, the programmed socket is inserted in place of the old IC and then the new IC is plugged into the company's board. This allows many sources to be tapped and facilitates the evaluation of new boards.

The 0.385-in.-high socket meets industry standards with a thermoplastic insulator having an Underwriters Laboratories flammability rating of 94 V-O, as well as double-sided selective gold-plated contacts with closed entry for simplified insertion.



Priced at $4 each in orders of 10,000 pieces, the socket is available in 10 days.

4C Electronics Inc., 9330 Progress Pkwy., P.O. Box 868, Mentor, Ohio 44060. Phone (216) 354-6800 [Circle 379]

## Power modules let timers run on variety of voltages

**A simple plug-in power** module converts timers in the Martec (Tele-Haase) solid-state line to operation with one of many ac or dc voltages. The product line includes time-delay, interval, on-off, recycling, and flasher options.

The timers are available with one or two Form C connectors rated at 10 A; they mount in panels, on chassis, in 8- or 11-pin octal sockets, or on rails. Accuracy of the complementary-MOS timing circuitry is specified as ±0.05%. Light-emitting-diode on/off indication

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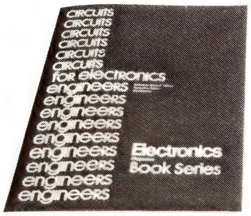

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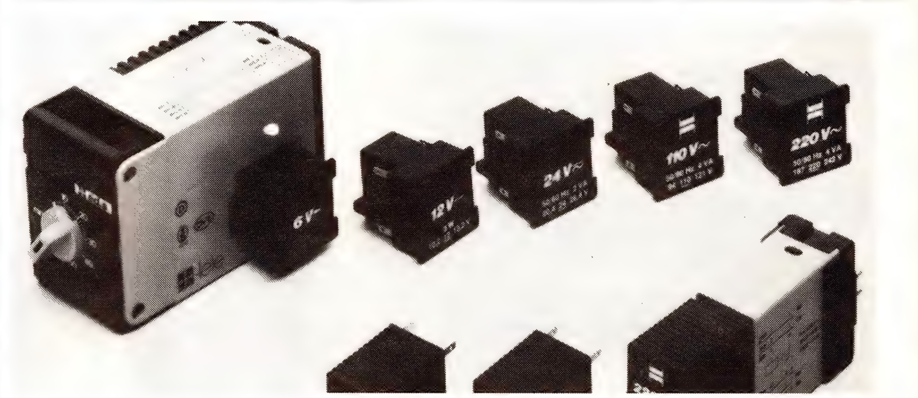


is standard, and remote operation is possible with an external potentiometer.

Power modules adapt the timers to 24, 42, 48, 110, 220, 240, or 380 V ac and 6, 12, 60, or 110 V dc. Ac/dc modules are available for operation at 24, 36, 42, and 48 V. Time ranges are from 0.05 s to 100 min.

Available now, a Slim-Line octal-base on/off delay timer with 10-A single-pole, double-throw switch, type PE or PR, sells for $22.22 each.

Martec Associates Inc., 1510 Jarvis Ave.,
Elk Grove Village, Ill. 60007.
Phone (312) 956-8090 [Circle 377]

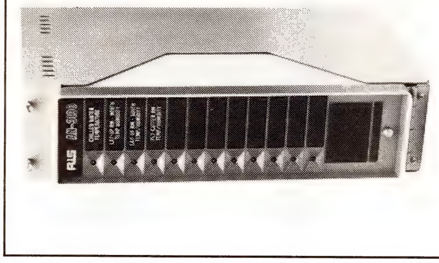
## 12-point monitor watches contacts wired in series by sensing voltage across trip inputs

**A light-emitting-diode** annunciator designed to monitor up to 12 alarm or shutdown contacts wired in series suits boiler control, mining, motor control, or assembly-line applications. It indicates all contact openings and highlights the one that opened first by flashing.

The AN-3190 senses voltage across the contacts; similar annunciators monitor contact current, and require shunting this current around the contacts and into the annunciator. Monitoring voltage eliminates relay-dropout problems and the need to select current-limiting resistors for the input. Voltage across trip inputs can be sensed from 300 down to 1 V, ac or dc. Relay output is provided for retransmission to a computer.

Up to four AN-3190 annunciators can be grouped to provide first-out monitoring of up to 48 series contacts. The base price is $750 in single units and deliveries take four weeks.

Rochester Instrument Systems, 255 N. Union St., Rochester, N.Y. 14605
Phone (716) 263-7700 [Circle 375]



## Signal-conditioning modules for three jobs added to line

**Expanding the options** for the maker's 3B-series signal-conditioning subsystem, six modules target strain-gage, dynamic-voltage, and power-monitoring applications. The 3B18 provides bridge excitation and amplification of strain-gauge bridges ranging from 100 Ω to 10 kΩ, and has a typical bandwidth of 20 kHz.

The 3B40 and 3B41 modules offer 10-kHz dynamic-voltage capability at ±1 mV to ±1 V and ±1 V to ±10 V, respectively. Ac-input modules include the 3B42, which has an input range of 20 mV to 1 V; the 3B43, for inputs of 1 to 50 V; and the 3B44, for 50-to-550-V inputs.

All 3B-series input modules provide simultaneous voltage (0 to 10 V or ±10 V) and current-loop outputs. The 3B18 and 3B41 are priced at $175 each; the 3B40, 3B42, and 3B43 are $200.

Analog Devices Inc., 3 Technology Way,
Norwood, Mass. 02062.
Phone (617) 329-4700 [Circle 376]

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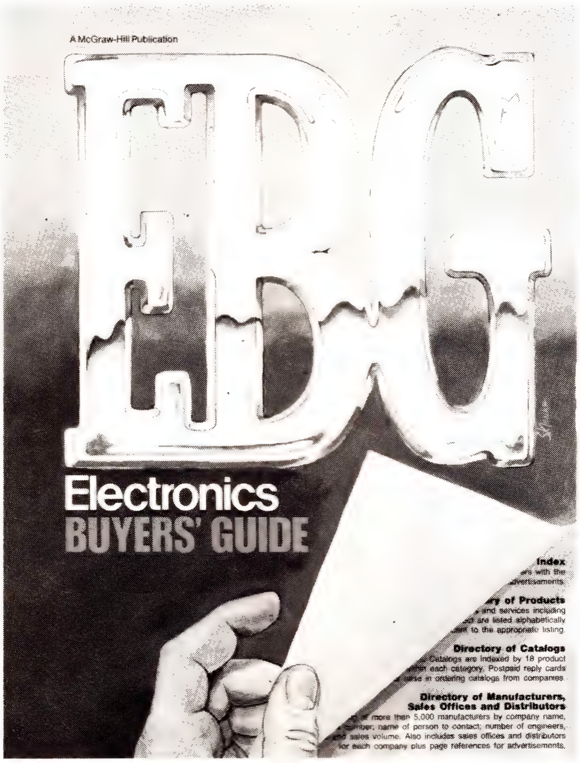
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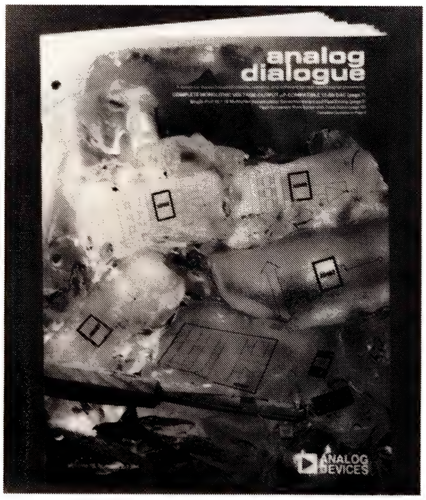


**Data forum.** A quarterly journal, *Analog Dialogue*, offers a mix of articles, new product briefs, and reviews of new publications to engineers working with integrated circuits or discrete analog, conversion, data-handling, and display circuits and systems. The current issue (Vol. 18, No. 2) features such articles as "Complete general-purpose 12-bit D/A converter" (the AD667), and "Single-port 16 x 16 multiplier-accumulator" (the ADSP-1110). A free copy is available from Analog Devices Inc., 2 Technology Way, P.O. Box 280, Norwood Mass. 02062. [Circle reader service number 421]

**Liquid assets.** A 20-page brochure on conductance-actuated liquid-level controls, "When Level Control Is Absolutely Essential," spells out the operating principle of a basic system. Applications cited are pumps, boilers, steam cookers, and carbonated-drink dispensers. The brochure's back holds an extensive catalog of the manufacturer's controls, fittings, and electrodes. For a free copy, write to Warrick Customer Service, 1964 W. Eleven Mile Rd., Berkley, Mich. 48072. [Circle 423]

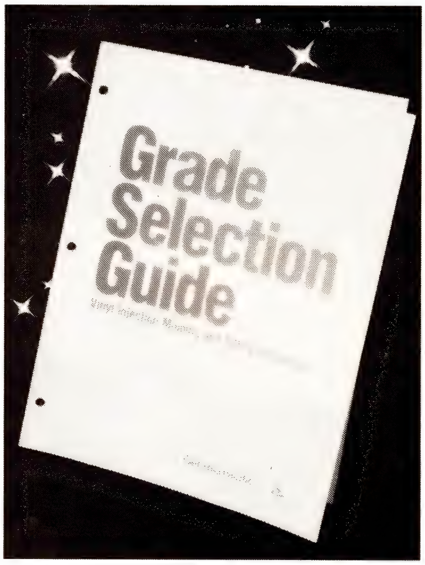
**Specs roundup.** Standards and specifications for glass-to-metal seal packaging have been brought together in Joint Electron Device Engineering Council Standard No. 9, "Metal Package Specification for Microelectronic Packages and Covers." This standard establishes the general requirements and quality assurance provisions that can be specified and met in procuring microelectronic packages and covers. The document was prepared by the Jedec JC-13.5 Committee on Hybrid Microcircuit Technology. Copies are available for $17 each from the Standard Sales Office, Electronics Industry Association, 2001 Eye St. N.W., Washington, D.C. 20006. [Circle 422]

**Telecommunications digest.** The *Digest of Technical Information*, a new monthly publication directed at telecommunications suppliers, summarizes technical information from regional telecommunications companies. Announced regular features will be Technical Advisories offered as drafts for industry comment, plus Technical References (the standard form for technical information), which are the final versions of the Technical Advisories. It will also cover activities including presentations and forums. Single copies are $2, and annual subscriptions are $20. Order from District Manager, Information Exchange Management, Technology Systems, Bell Communications Research, 30 Vreeland Rd., Room S103, Florham Park, N.J. 07932. [Circle 427]

**Software unraveled.** The second edition of the *Unix System III Guide* describes standard Unix software for those managers contemplating the installation of a Unix system but who don't care to take on the three-volume programmer's manual. System V, System III, Version 7, UniPlus+, and Berkeley enhancements are covered, as are microcomputer applications. Commands, libraries, system calls, and reference documentation are included, and the guide is indexed. The book is oriented to the new user and systems buyers, and some knowledge of software is assumed. Its single-copy price is $24.95 plus a shipping charge of $2, and discounts are available for quantity orders. Order from Pacific Micro Tech, 5819 Poinsett Ave., El Cerrito, Calif. 94530. [Circle 425]

**Trigger happy.** A free set of six applications notes on remotely programmable, modular triggering systems is directed at engineers and scientists working in nuclear, fusion, and high-energy physics, and heavy-ion research. The notes include an introduction to the ECLine system of CAMAC programmable logic modules and presents examples of implementation. Order by number and title, as follows: AN 4001, ECLine Application Note; AN 4004, FERA Fast Encoding and Readout ADC System Possibilities; AN 4005, Using ECLine for Majority Calculations in Fast Triggering; AN 4006, Using ECLine in a Recoil Proton Trigger, AN 24A, Trigger Processors with ECLine Data Handler Modules; and TDS 4800 Series CAMAC Boosters. For separate copies or the whole set, write to LeCroy Research Systems Corp., Marketing Services, 700 S. Main St., Spring Valley, N.Y. 10977. [Circle 426]

**Vinyl update.** The latest grade-selection guide for this manufacturer gives specifications for 13 rigid vinyl injection-molding and pipe-fitting compounds. Properties summarized include specific gravity, tensile modulus, izod impact, heat deflection, and Underwriters Laboratories' flammability ratings, for applications in computers, electrical work, housewares, and medicine. The "Grade Selection Guide: Vinyl Injection Molding and Fitting Compounds" is available at no charge from Georgia-Pacific, P.O. Box 105605, Atlanta, Ga. 30348. [Circle 424]



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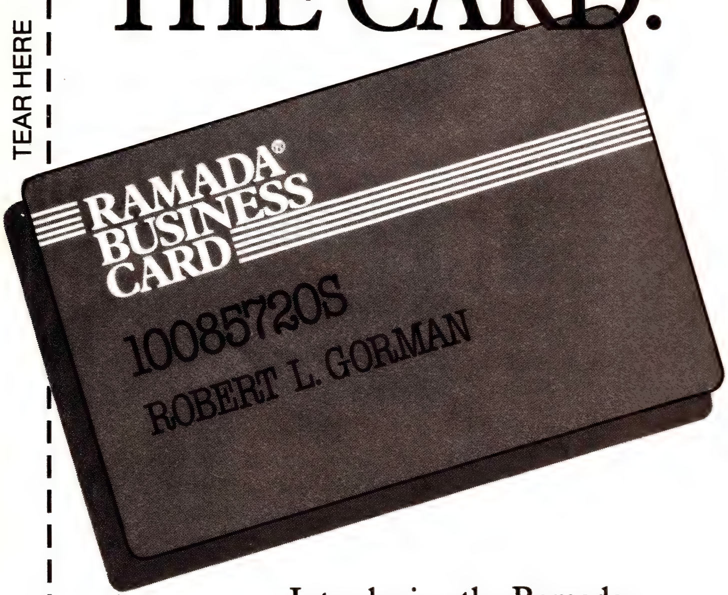

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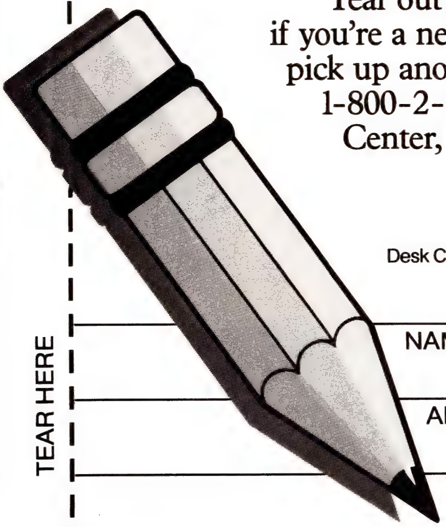

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# TECHNOLOGY ISSUES A MUST FOR CAMPAIGN

As the 1984 presidential hopefuls officially kicked off their campaigns last week, the issues that they have defined as the election battleground do not have much to do with science and technology. This is indeed unfortunate in a nation that is leading the industrialized world in newly developing technologies, especially when it is clear that the quality of life for future generations of Americans will hinge on what technical policies prevail in the next few years.

It is appropriate that the candidates reveal their positions on the future funding of pure research. What level of priority does each place on long-term research? Do they agree on its need? Must it be tied to a specific goal, as is often the case in the space program?

What about computer literacy? The presidential opponents should be clear in their statements on computer education. In as little as 15 years, the U.S. could well have two classes of young adults entering the work force: those who are computer-smart and those who aren't. What do the candidates think about funding computer education in primary schools? Is that a job best left to parents, or should the government require local districts to establish curriculums that include computer use in early education?

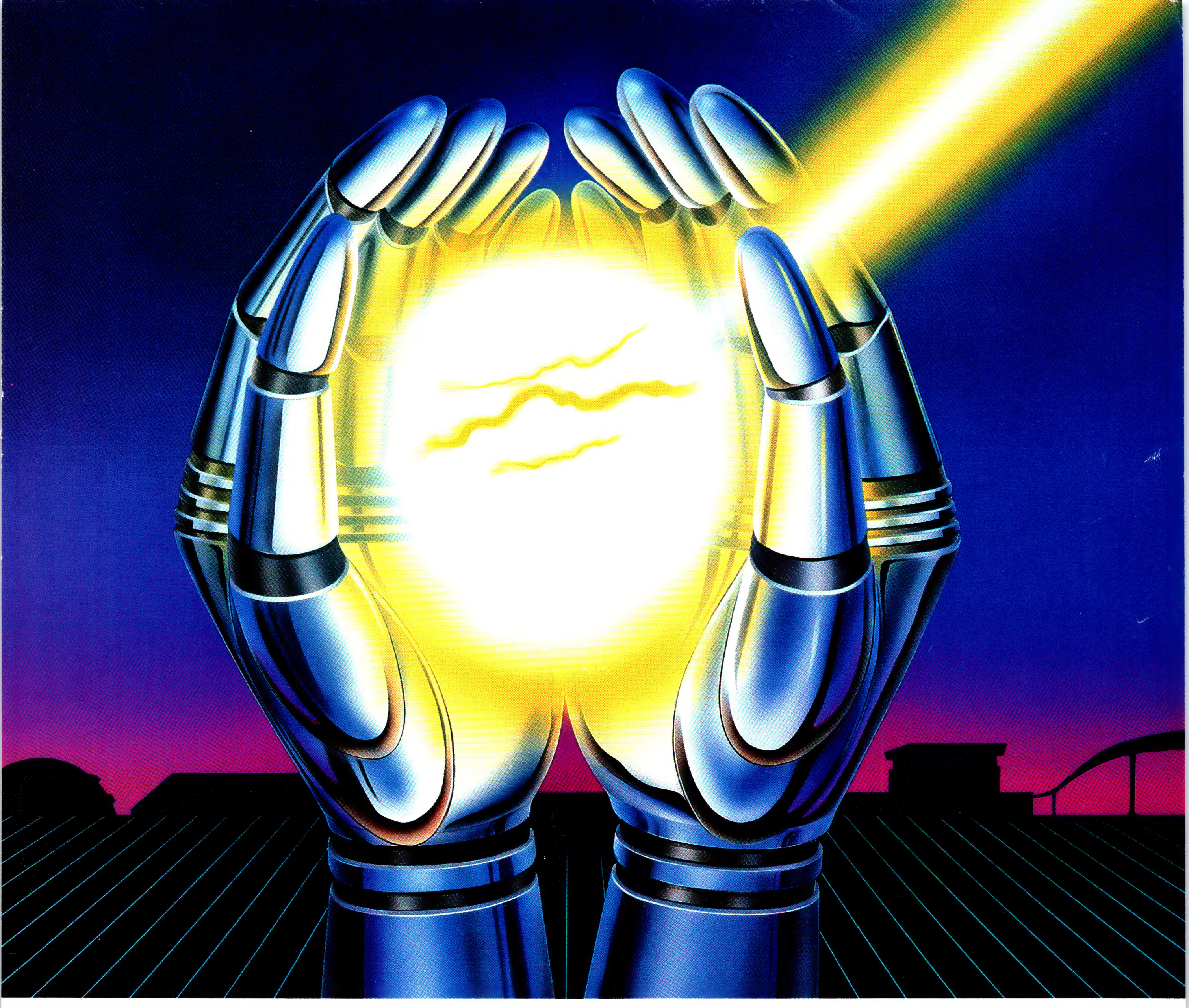
The candidates would also do well to address the issue of the long-overdue cabinet post dedicated to technology and its assessment, applications, and impact.

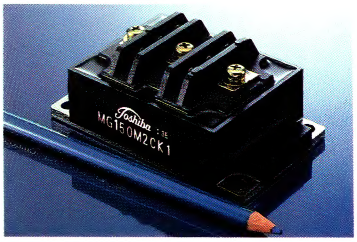
A host of other technology issues of crucial importance remains to be addressed and debated at the highest levels. The foreign-student question is not going away. Foreign students are filling more and more science and engineering positions in the United States. Is this a boon or a problem? The nagging question of health and safety in high-technology jobs must be discussed. The impact of high technology on the modern social system has to be explored more deeply.

Unless these issues are examined soon in more detail through the elective process, they will be answered without the benefit of an enlightened population. The time is now and the forum exists. In four or eight years, it may be too late.

# FEERST AMENDMENT MAKES GOOD SENSE

Irwin Feerst has petitioned the IEEE membership to adopt a constitutional amendment to require that the IEEE's vice president for professional activities be elected by the full membership instead of by a vote of the board of directors. In addition, Feerst's amendment calls for an individual to serve as vice president for professional activities for four years instead of for one, as the constitution now mandates. We support Feerst's proposal. Coordination of professional activities is the cornerstone of the IEEE's charter and as such requires a leader selected by the entire membership. After all, the full membership contains a diversity of engineers and a variety of professional goals. As to the length of term, four years is a much more reasonable period to effect change—and change is needed.





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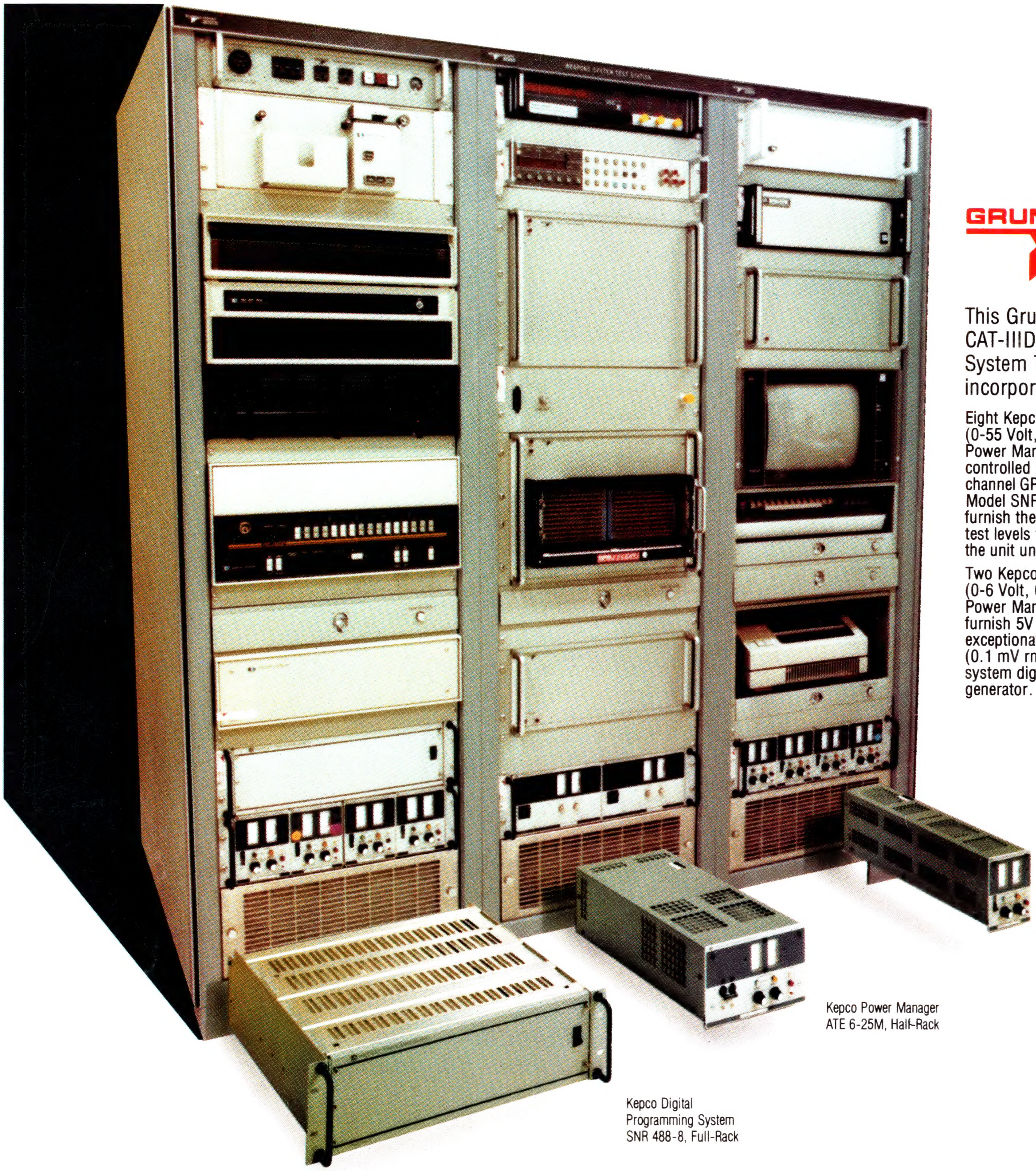

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